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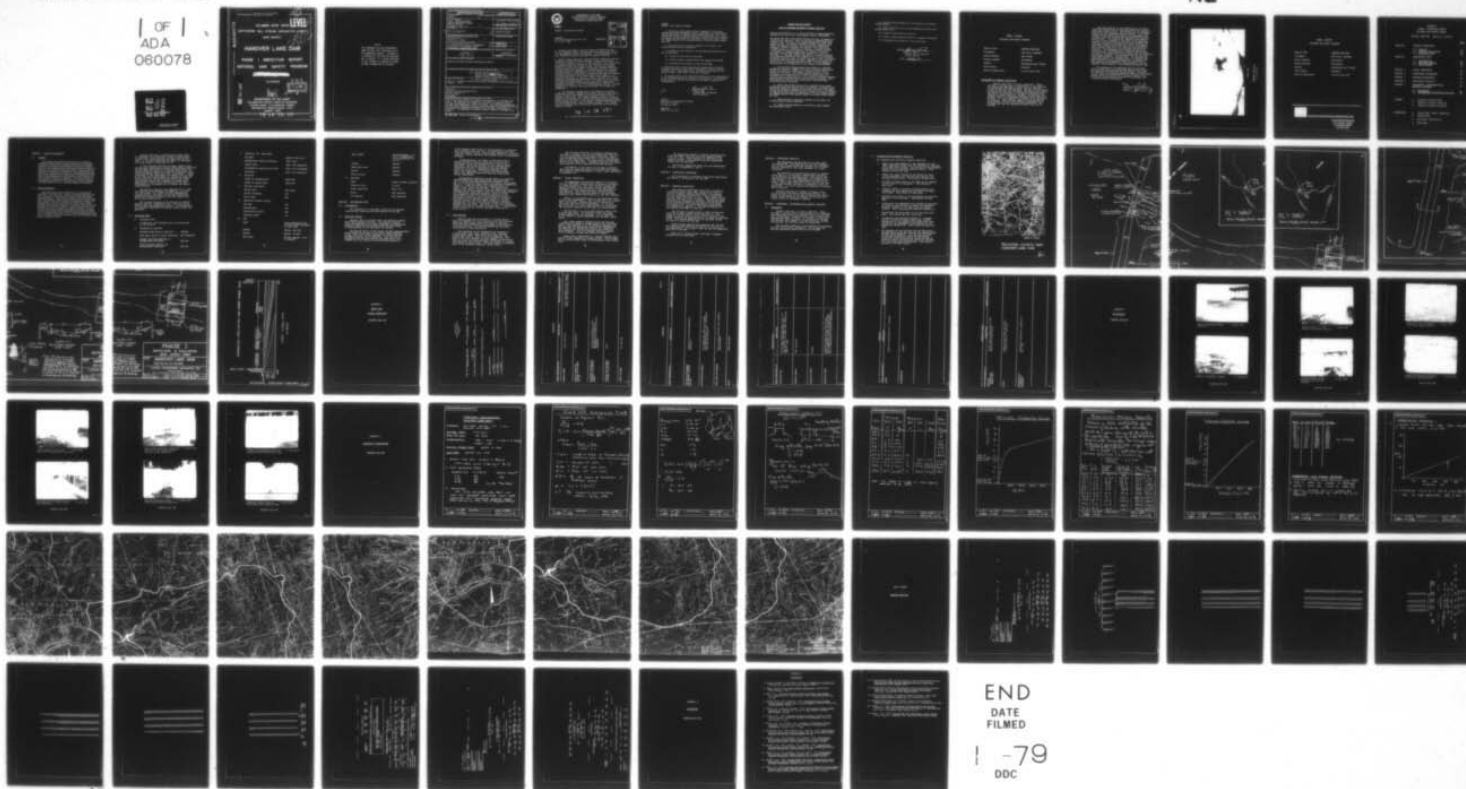
NEW JERSEY STATE DEPT OF ENVIRONMENTAL PROTECTION TRENTON F/G 13/2
NATIONAL DAM SAFETY PROGRAM. HANOVER LAKE DAM (NJ00459), DELAWA--ETC(U)
AUG 78 D J LEARY

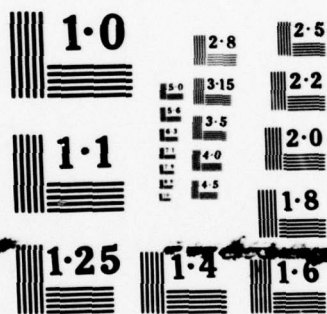
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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NJ00459	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Hanover Lake Dam Burlington County, N.J.	5. TYPE OF REPORT & PERIOD COVERED ⑨ FINAL / Rpt.	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) ⑩ Dennis J. Leary, P.E.	8. CONTRACT OR GRANT NUMBER(s) ⑪ DACW61-78-C-0124	9. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
10. PERFORMING ORGANIZATION NAME AND ADDRESS Langan Engineering Associates, Inc. 970 Clifton Ave. Clifton, N.J. 07013	11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, Philadelphia Custom House, 2d & Chestnut Streets Philadelphia, Pennsylvania 19106	12. REPORT DATE August, 1978
13. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) ⑫ 79p.	14. SECURITY CLASS. (of this report) Unclassified	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
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18. SUPPLEMENTARY NOTES Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dams--N.J. National Dam Safety Program Phase I Hanover Lake Dam, N.J. Dam Inspection Dam Safety		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.		



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-D

SUBJECT: Dam Inspection Program

Commander
U.S. Army Training Center & Ft. Dix
Ft. Dix, NJ 08640

28 SEP 1978

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1. Inclosed is the Phase I Inspection Report for Hanover Lake Dam, Ft. Dix, Burlington County, New Jersey which has been prepared for the U.S. Army Engineer District, Philadelphia. A brief assessment of the dam's condition is given on the first four pages of the report.

2. Based on visual inspection, available records, calculations and past operational performance, Hanover Lake Dam, a high hazard potential structure, is judged to be in poor overall condition. Also, the spillway is considered seriously inadequate since 18 percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant, engaged by the owner, using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Any remedial measures necessary to insure the adequacy of the spillway and to prevent overtopping should be initiated within calendar year 1979. In the interim, a detailed emergency operation plan and warning system, should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

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NAPEN-D

SUBJECT: Dam Inspection Program.

b. Within three months from the date of approval of this report, engineering studies and analysis should be performed to determine the dam and spillway foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1979.

c. Within one year of the date of approval of this report, the following actions should be completed:

(1) Replace the wood sheeting at the spillway bridge abutments with steel sheet piling.

(2) Provide a bottom outlet for the lake.

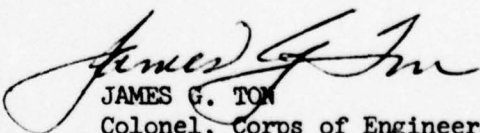
(3) Provide a means to prevent debris from clogging the spillway.

(4) Re-establish the elevations of the existing gage.

3. Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

4. An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken to implement our recommendations.

1 Incl
as


JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Cy Furn:
Directorate of Engineering & Housing
U.S.A.T.C. & Ft. Dix
Ft. Dix, NJ 08640

DAEN-FEB-P
ATTN: Mr. Leo Price

HANOVER LAKE DAM (NJ00459)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 6, 14, and 19 July 1978 by Langan Engineering Associates, Inc. for the U.S. Army Engineer District, Philadelphia.

The Hanover Lake Dam, a high hazard potential structure, is judged to be in poor overall condition. Also, the spillway is considered seriously inadequate since 18 percent of the Probable Maximum Flood (PMF) would overtop the dam. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

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b. Within three months from the date of approval of this report, engineering studies and analysis should be performed to determine the dam and spillway foundation condition and structural stability. This should include test borings to determine material properties relative to stability and seepage and installation of piezometers to facilitate seepage studies. Any remedial measures found necessary should be initiated within calendar year 1979.

c. Within one year of the date of approval of this report, the following actions should be completed:

(1) Replace the wood sheeting at the spillway bridge abutments with steel sheet piling.

(2) Provide erosion protection for the surfaces of the spillway bridge abutments.

(3) Remove all trees on and near the embankment, and replace with suitable ground cover.

(4) Provide a bottom outlet for the lake.

(5) Provide a means to prevent debris from clogging the spillway.

(6) Re-establish the elevations of the existing gage.

APPROVED:

James G. Ton
JAMES G. TON

Colonel, Corps of Engineers
District Engineer

DATE:

28 Sep 78

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

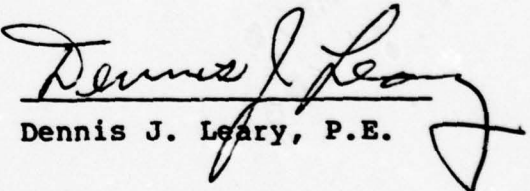
Name of Dam:	HANOVER LAKE DAM
ID Number:	Fed ID No. NJ00459
State Located:	New Jersey
County Located:	Burlington
Stream:	Hartshorne Mill Stream
River Basin:	Delaware
Date Of Inspection:	6,14,19 July 1978

ASSESSMENT OF GENERAL CONDITIONS

Hanover Lake Dam is in poor condition. There has been a serious lack of maintenance of the upstream and downstream embankment slopes and the abutments of the bridge over the spillway. Because of its present condition and the lack of design and construction data, the degree of stability of the dam and spillway with respect to slope stability, seepage, overturning, and sliding cannot be adequately evaluated using analytical methods. It is our opinion the stability of the dam is marginal. The spillway capacity as determined by CE screening criteria is seriously inadequate. We estimate the dam can adequately handle only 17% of the PMF.

The wood sheeting at the abutments of the cable supported bridge over the spillway should be replaced with steel sheet piling. The surface of the abutments should also be protected against erosion. All trees located on and within the area of the embankment and spillway should be removed and replaced with suitable ground cover. A bottom outlet should be provided so the Lake can be lowered in the event of an emergency. A means to prevent floating debris from clogging the free space above the spillway and below the bridges should be provided and, the nature of the foundation and backfill material of the spillway should be determined. The embankment and foundation materials should also be investigated by means of test borings to obtain the necessary material properties for stability and seepage studies. The elevations on the existing staff gage should be reestablished. To evaluate the possible presence of a seepage cutoff or adverse seepage condition, piezometers should be installed at the upstream and downstream cross section of the embankment, particularly in the downstream marshy area.

The capacity of the spillway and the spillway design flood should be determined using more precise and sophisticated methods and procedures. The need for and type of mitigating measures should be determined. Around the clock surveillance during periods of unusually heavy precipitation should be provided, and a warning system established.


Dennis J. Leary, P.E.



OVER VIEW

HANOVER LAKE DAM

19 July 1978

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam:	HANOVER LAKE DAM
ID Number:	Fed ID No. NJ00459
State Located:	New Jersey
County Located:	Burlington
Stream:	Hartshorne Mill Stream
River Basin:	Delaware
Date Of Inspection:	6,14,19 July 1978



LANGAN ENGINEERING ASSOCIATES, INC.

Consulting Civil Engineers
970 CLIFTON AVENUE
CLIFTON, NEW JERSEY
201-472-9366

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NATIONAL DAM SAFETY REPORT

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SECTION 1 PROJECT INFORMATION

1.1 General

The purpose of the Phase I investigation is to develop an assessment of the general conditions with respect to the safety of Hanover Lake Dam and appurtenances based upon available data and visual inspection and, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted. The assessment has been made using screening criteria established in Recommended Guidelines for Safety Inspection of Dam prepared by the Department of Army, Office of the Chief of Engineers. It is not the purpose of the inspection to imply that a dam meeting or failing to meet the screening criteria is, per se, certainly adequate or inadequate.

1.2 Project Description

The Hanover Lake Dam is a 300-ft-long, 15-ft-high earth dam with a 12-ft-wide crest. There is a foot path along the crest and a bridge over a concrete block spillway section with wood sheeting sidewalls. The spillway is located at the left side of the dam. The bridge is a cable suspended aluminum truss bridge with wood decking. The dam is located in the North East corner of Burlington County at the southern end of Hanover Lake at $30^{\circ}58'54''$ latitude and at $74^{\circ}32'00''$ longitude. Hanover Lake has an area of about 90 acres and is oriented in a northeast direction. The Lake is about one-half mile long and the width varies from about 500 ft at the southwest end to about 1,000 ft at the northeastern end of the Lake. A regional vicinity map is given in Fig 1 and essential project features are given in Fig 2.

Hanover Lake Dam is classified as being small on the basis of its reservoir storage volume, which is less than 1,000-acre-feet but more than 50-acre-feet. It is also classified as "Small" on the basis its total height is less than 40 ft.

In the National Inventory of Dams, Hanover Lake Dam has been classified as having "High Hazard Potential" on the basis that failure of the dam would cause excessive property damage to residences downstream, and could potentially cause more than a few deaths. Visual inspection of the downstream area showed that a breach of the dam would cause damage to residences along the shore of Mirror Lake which would receive the flood from Hanover Lake and be hazardous to people using Hanover Blvd. about 500 ft downstream of the dam. Accordingly it is proposed not to change the hazard classification.

The dam and reservoir were reported by N.J. DEP to be owned by the Township of Pemberton, P.O. Box 175, New Lisbon, N.J. 08064. We have subsequently learned from Mr. M.Colbert of the Post Engineering staff that the dam is owned by the U.S. Army, Fort Dix Military Reservation.

The original purpose of the dam was to impound Hanover Lake for recreational use. The Lake is now used for military amphibius training. No information is available concerning its design, construction, and operation.

1.3 Pertinent Data

a. Drainage Areas

At dam site, the drainage area is 12,650 acres or 19.77 sq mi

b. Discharge at Dam Site

Maximum known flood at Dam Site:	Unknown
Warm water outlet at pool elevation:	None Observed
Ungated spillway capacity at maximum pool elevation:	830 cfs
Total spillway capacity at maximum pool elevation:	830 cfs

- c. Elevation (ft. above MSL)
- | | |
|---------------------------------|----------------------|
| Top dam: | Approx. Elev 69.6 |
| Maximum pool design surcharge: | Elev. 69.6 |
| Normal Pool: | Elev. 65.5 observed |
| Streambed at centerline of dam: | Elev. 62.0 estimated |
| Tailwater: | Elev. 63.0 observed |
- d. Reservoir
- | | |
|-------------------------|-----------|
| Length of maximum pool: | 4000 feet |
| Length of normal pool: | 2000 feet |
- e. Storage (acre-feet)
- | | |
|-------------------|------------|
| Normal Pool: | 450 (est.) |
| Design surcharge: | 430 |
| Top of dam: | 880 |
- f. Reservoir Surface (acres)
- | | |
|---------------------|-----|
| Top dam: | 100 |
| Maximum pool: | 100 |
| Flood-control pool: | 100 |
| Spillway crest: | 90 |
- g. Dam
- | | |
|------------|---|
| Type: | Earth embankment with concrete block spillway at left side. |
| Length: | Approx. 300 feet |
| Height: | Approx. 15 feet |
| Top width: | Varies, approx. 12 ft is typical. |

Side slopes:	Upstream-approx. 2 H to 1 V. Downstream-varies generally 3 H to 1 V.
Zoning:	Unknown
Impervious core:	Unknown
Cutoff:	Unknown
Grout curtain:	Unknown
h. Spillway	
Type:	Broad crested; concrete
Length of weir:	33 feet
Crest elevation:	Elev. 65.1
Gates:	None Observed
U/S Channel:	None Observed

SECTION 2 ENGINEERING DATA

2.1 Introduction

No information is available concerning the design, construction, operation and maintenance of the dam.

2.2 Regional Geology

Hanover Lake is located within the Atlantic Coastal Plain Physiographic Province. The Atlantic Coastal Plain has essentially the same topography and underlying geologic formations and extends from the Grand Banks of Newfoundland to the Peninsula of Yucatan.

The Coastal Plain in New Jersey includes approximately three-fifths of the area of the State lying southeast of the "fall-line" which separates the Plain from the Piedmont Province on the northwest. The "fall-line" represents the division between the hard rock of the Piedmont and the primarily unconsolidated materials

of the Coastal Plain which is often marked by a waterfall where streams cross the line. In New Jersey, the line runs from Staten Island, through South Brunswick, Princeton Junction, Trenton and down the Delaware River to Wilmington, Delaware.

Topographically, the Plain is characterized by gently rolling hills and ridges which reflect the resistance of the underlying strata on the surficial materials. More than one-half of the Coastal Plain lies below the 100 ft elevation while the highest elevation is 391 ft. Immediately adjacent to the coast the topography is a nearly flat featureless plain with numerous estuaries resulting from stream valley submergence.

The geologic formations of the Plain are primarily unconsolidated and semiconsolidated Cretaceous Age (65 to 140 million years before the present) and Tertiary Age (1 to 65 million years before the present) sedimentary deposits. These formations are composed mainly of sands, clays, marls, and gravels. The Quaternary deposits are usually coarser than the underlying formations. Capping most of the highest elevations and stream divides are Quaternary Sands and gravels, primarily flood plain deposits laid down during the melting of the continental glaciers. All of the geologic formations dip gently to the southeast which result in a "roof shingle" pattern with the oldest formation (Raritan) exposed near the fall line and the youngest (Cohansey) exposed near the coast. The depth to the hard indurated basement rock may be as much as 6,000 feet. A generalized cross-section of the regional geologic features is given in Fig 3.

2.3 Site Geology

Hanover Lake Dam is located in a stream valley which is composed of recent alluvium with the surficial materials containing a high percentage of organics. These manifest themselves as wet swampy areas adjacent to stream courses. The dam embankment may have been constructed on these materials.

The abutments of the embankment are composed of a stratified, light gray, slightly silty, narrowly graded quartz sand. Some minor clay seams and thin gravel beds could be seen in local excavations. The sand on the left abutment has been mapped as containing less silt than the right abutment and ranging in texture from medium to coarse sand. These materials are probably part of the Kirkwood formation. (Rush, 1962).

The Kirkwood formation is typically composed of two units, an upper unit of very light gray, very fine to fine grained well sorted quartz sand and a basal unit of brownish-black clayey silt to very fine grained quartz sand (Rush 1962). We would have to assume that we are in the upper unit. Competent bedrock is probably many hundreds of feet beneath the ground surface.

Groundwater in the region of the dam is shallow, very near the same elevation of the downstream channel. The abutment formations appear to have a high coefficient of permeability.

SECTION 3 VISUAL INSPECTION

The embankment and spillway appear to be stable with no observable indications of excessive settlement or slope instability. The crest and both slopes have heavy vegetation and trees which could cause piping problems. Erosion has occurred at both abutments of the spillway. The wooden spillway sidewalls which also serve as earth retaining walls at the spillway abutments have failed particularly at the left abutment.

There is a wet marshy area at the downstream side of the right embankment. This is reported to be trapped water and runoff. Seepage may also be occurring in this area and should be investigated. At the left end of the dam is a staff gage mounted on a wood pole. The elevation numerals on the gage are undiscernable.

The spillway is a 10-ft-wide concrete block with a 33-ft-long crest. An aluminum bridge with wood decking passes over the spillway. It is supported at the center by cable suspended from vertical timber poles.

The bridge support abutments form the spillway sidewalls and consist of timber-sheet earth retaining walls. The sheeting is at the spillway sidewalls and the upstream and downstream sides of the embankment. The sheeting has failed and erosion has occurred at both abutments. The left abutment material appears to be a mixture of sand and pieces of asphalt.

About 400-ft downstream is a concrete-decked steel girder bridge supported on timber piling. This bridge and its piling could cause an obstruction to the stream flow.

The downstream channel is heavily vegetated with brush and small trees and has side slopes of about 4 hor to 1 vert. Small amounts of wood debris and concrete blocks are scattered along the downstream slopes near the spillway.

The visual Inspection Check List and Photographs are given in Appendixes 1 and 2.

SECTION 4 OPERATIONAL PROCEDURES

No information is available concerning operational procedures or maintenance for the dam.

SECTION 5 HYDRAULIC/HYDROLOGIC

The hydraulic/hydrologic evaluation is based on a spillway design flood (SDF) equal to one half to the full probable maximum flood (PMF) in accordance with the evaluation guidelines for dams classified as high hazard and small in size. The original design data for this dam is not available. The PMF has been determined by developing a synthetic hydrograph based on the maximum probable precipitation of 24 inches (200 square mile - 24 hour) Hydrologic Computations are presented in Appendix 3. The PMF determined for the subject watershed is 5224 cfs.

The spillway is essentially a broad crested weir which has a small bridge traversing over it. The length of the spillway is 33 ft and the bottom of the bridge structure is approximately 4 ft above the spillway crest. The maximum capacity of the spillway is 830 cfs which is less than the SDF.

Flood routing calculations indicate that the dam will overtop under PMF and 1/2 PMF by 2.8 ft and 2.1 ft respectively. We estimate that the dam can adequately pass 17% of the PMF.

There are no outlet pipes, therefore, drawdown analysis has not been made.

SECTION 6 STRUCTURAL STABILITY

The embankment and spillway do not show signs of instability. The sheeting for the left abutment wall of the bridge across the spillway has collapsed and the sheeting at the right abutment is in poor condition.

The stability of the spillway itself is unknown since there is no available information concerning its foundation and upstream slope. The quality and characteristics of the embankment and foundation are also unknown. The right embankment is covered with trees. The present condition of the dam and the lack of information make any sort of computation very hypothetical. It is our opinion the stability of Hanover Dam is marginal.

Hanover Lake Dam is located in Seismic Zone 1 of the Seismic Zone Map of Contiguous States. The degree of stability of the dam is unknown and Conventional Safety Margins are assumed not to exist for either static or earthquake loading.

SECTION 7 ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Assessment

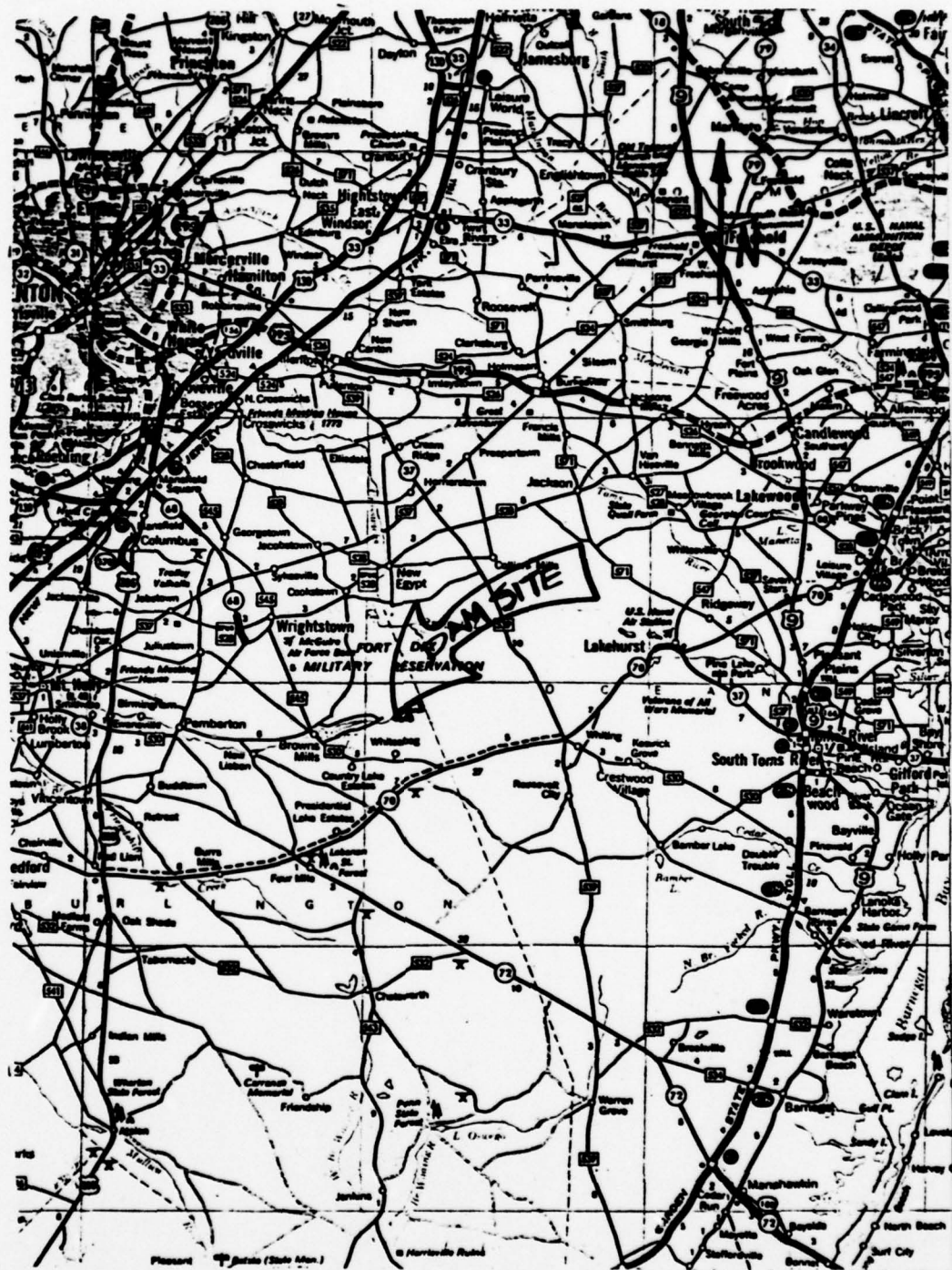
Hanover Lake Dam is in poor condition. There has been a serious lack of maintenance of the upstream and downstream slopes and abutment walls of the bridge over the spillway. Because of the lack of design and construction data the degree of stability of the dam and spillway with respect to slope stability, seepage, overturning, and sliding cannot be determined.

The spillway capacity as determined by CE screening criteria is seriously inadequate. We estimate the dam can adequately handle only 17% of the PMF.

7.2 Recommendations/Remedial Measures

We recommend the following remedial measures:

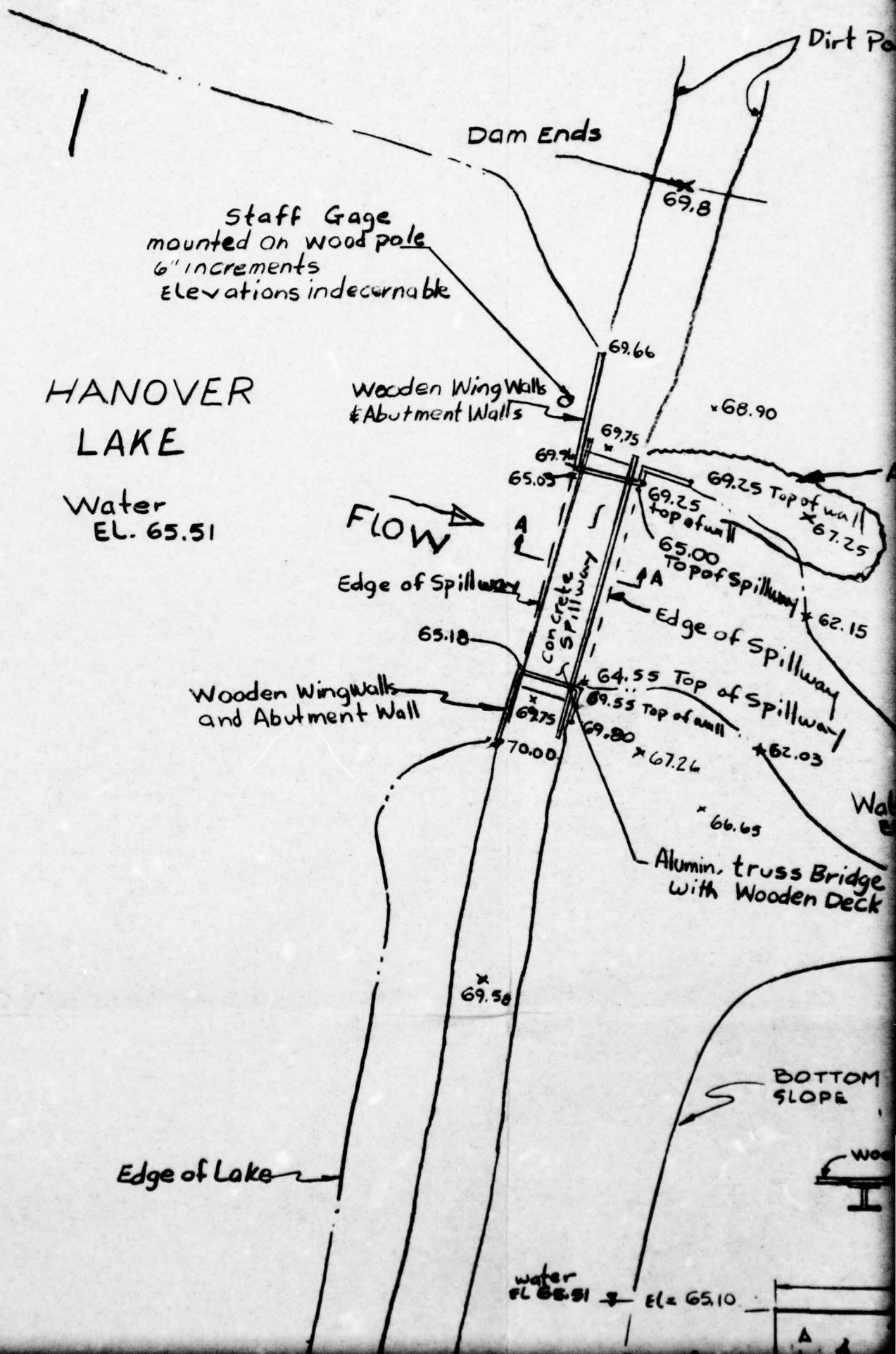
1. Repair the wood sheeting at the abutments of the cable supported bridge over the spillway by replacing with steel sheet piling. The surface of the abutments should also be protected against erosion. This should be done very soon.
2. Remove all trees located on and within the area of the embankment and spillway and replace with suitable ground cover. This should be done soon.
3. Provide a bottom outlet so the Lake can be lowered in the event of an emergency. This should be done soon.
4. Provide a means to prevent floating debris from clogging the free space above spillway and below the bridge. This should be done soon.
5. Determine the nature of the foundation and backfill material of the spillway. This should be done soon.
6. Investigate the embankment and foundation materials by means of test borings to obtain the necessary material properties for stability and seepage studies. This investigation should be done soon.
7. Reestablish the elevations on the existing staff gage. This should be done very soon.
8. To evaluate the possible presence of a seepage cutoff or adverse seepage conditions, install piezometers at the upstream and downstream cross section of the embankment, particularly in the downstream marshy area. This should be done very soon.
9. The capacity of the spillway and the SDF should be determined using more precise and sophisticated methods and procedures. The need for and type of mitigating measures should be determined. Around the clock surveillance during periods of unusually heavy precipitation should be provided, and a warning system established. This should be done in the near future.



SCALE: 1" ~ 6.7 MI.

REGIONAL VICINITY MAP HANOVER LAKE DAM

Fig. 1



2

PLAN

scale 1"=20'-0"

Washed out
(and wooden wingwall)

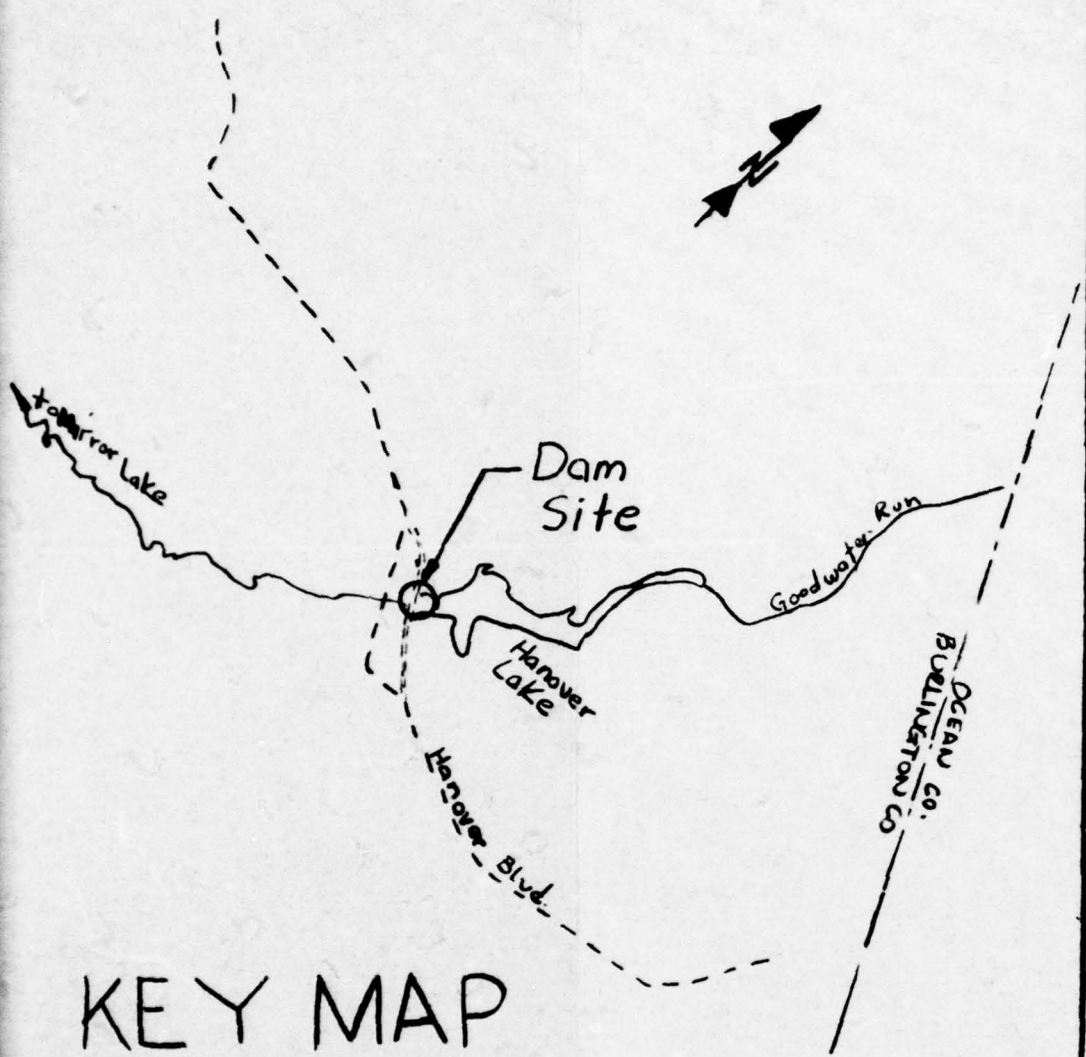
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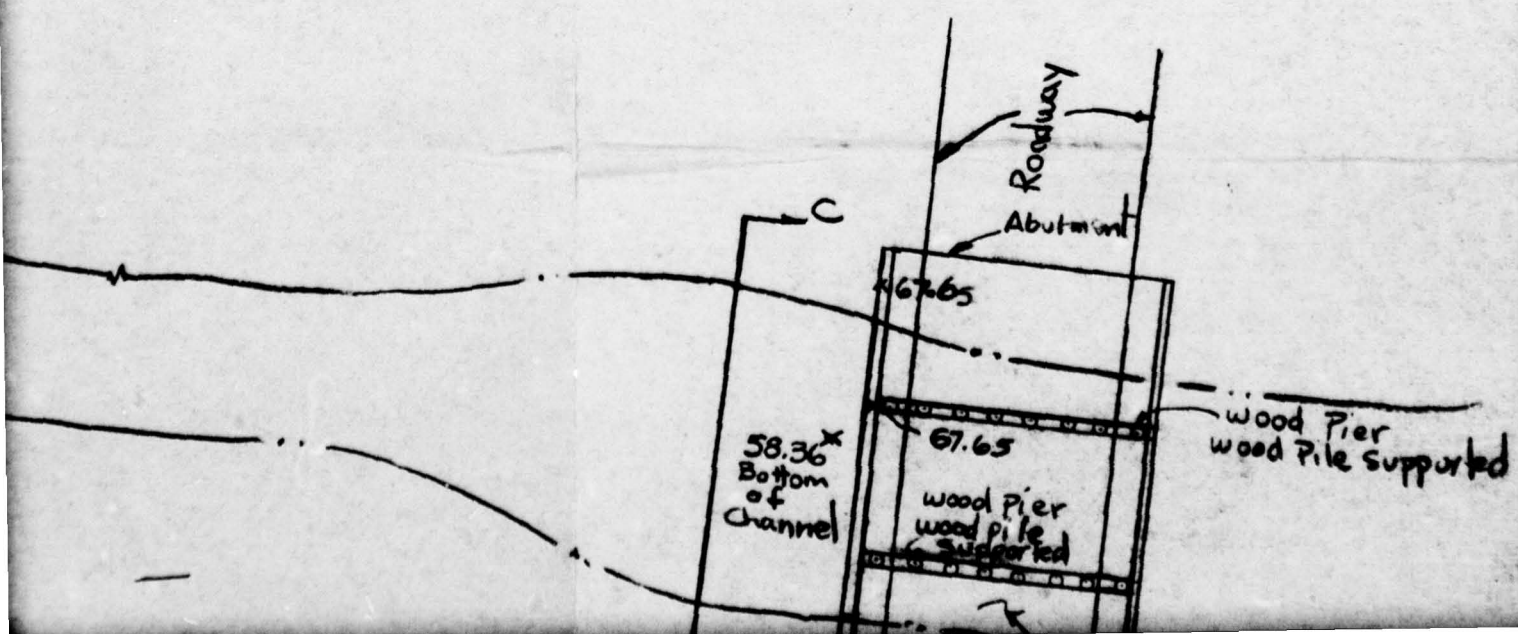
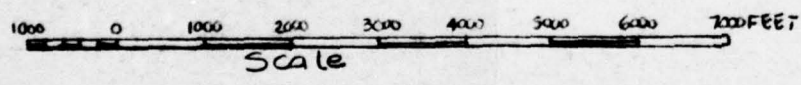
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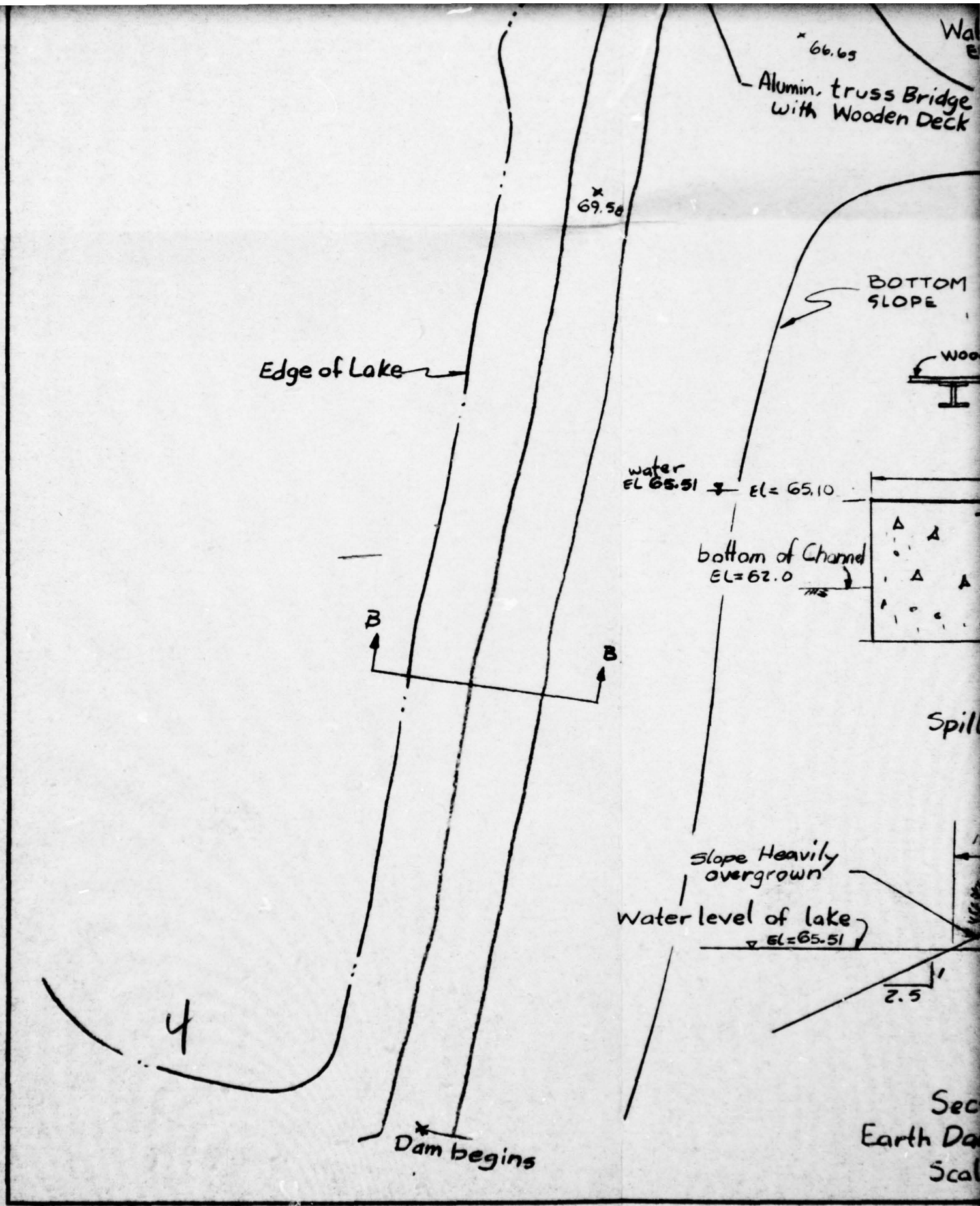
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KEY MAP





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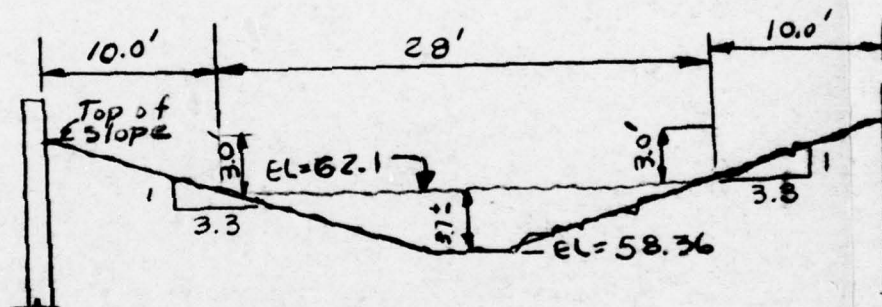
Scale

ridge EL=69.75

EL=64.8

bottom Channel
EL=62.0

58.36
Bottom
of
Channel



Section C-C

Down Stream Channel
Scale 1"=10'-0"

Slope Heavily
Overgrown

Standing
Water
(Source
Unknown)

Note: The Elevations were obtained using a surveyor's Transit and Level and USGS Map for the BROWN'S MILLS QUADRANGLE. The Reference Elevation of 70.00 was used and located at the top of the S. corner of the S. W. wing wall of the Bridge over the Spillway

INSPECT
NE

DRAWING
TITLE:

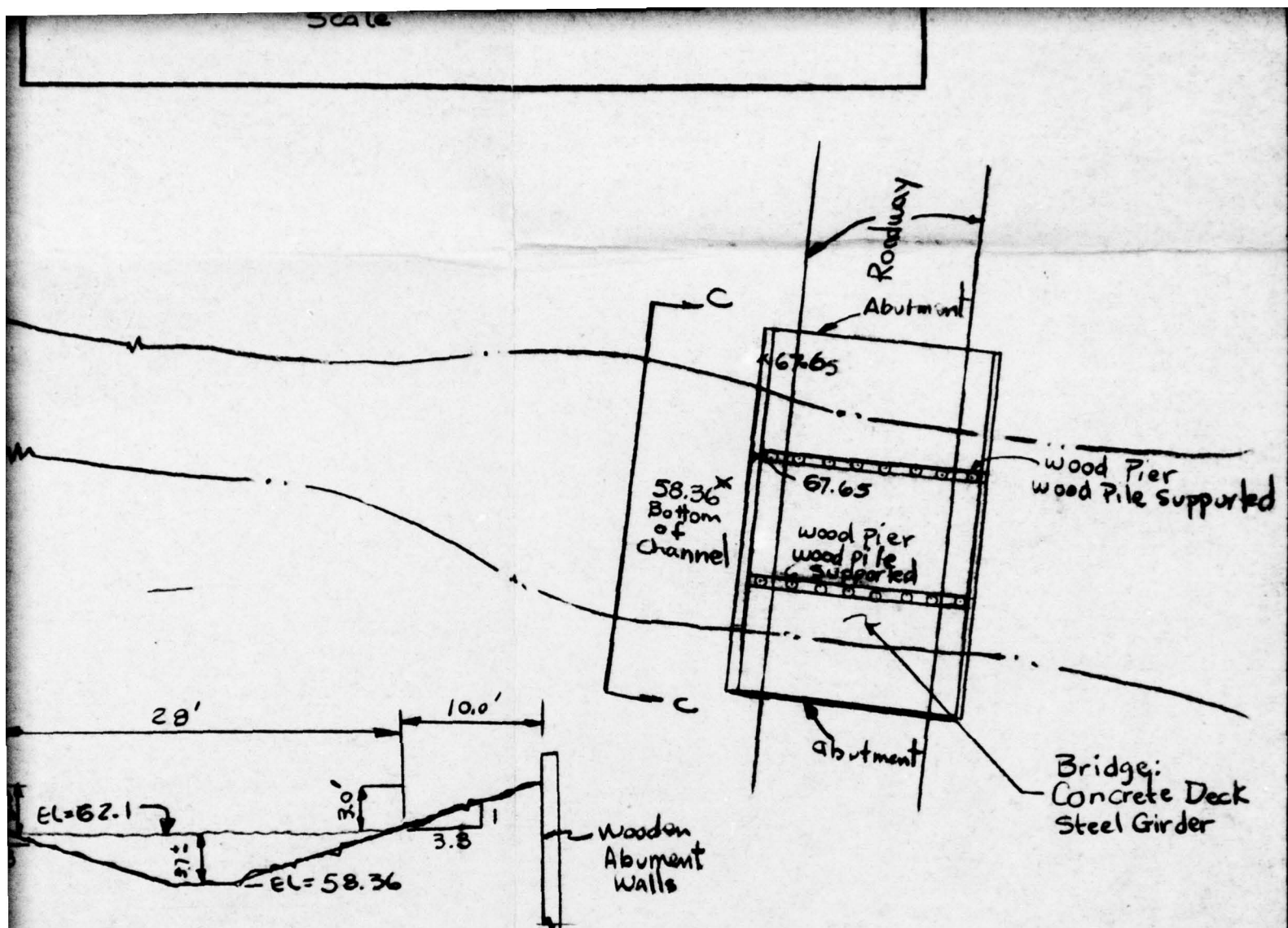
HANC
FED. ID.

LANGAN E

970 CLIFTO

DR. BY: J. C.

CK'D. BY: D.J.L.



PHASE I

INSPECTION & EVALUATION NEW JERSEY DAMS

DRAWING
TITLE:

HANOVER LAKE DAM

FED. ID. No. NJ 00459

LANGAN ENGINEERING ASSOCIATES, INC.

CONSULTING ENGINEERS

970 CLIFTON AVE. CLIFTON, N.J. 07013 201 472-9366

DR. BY: J.C.

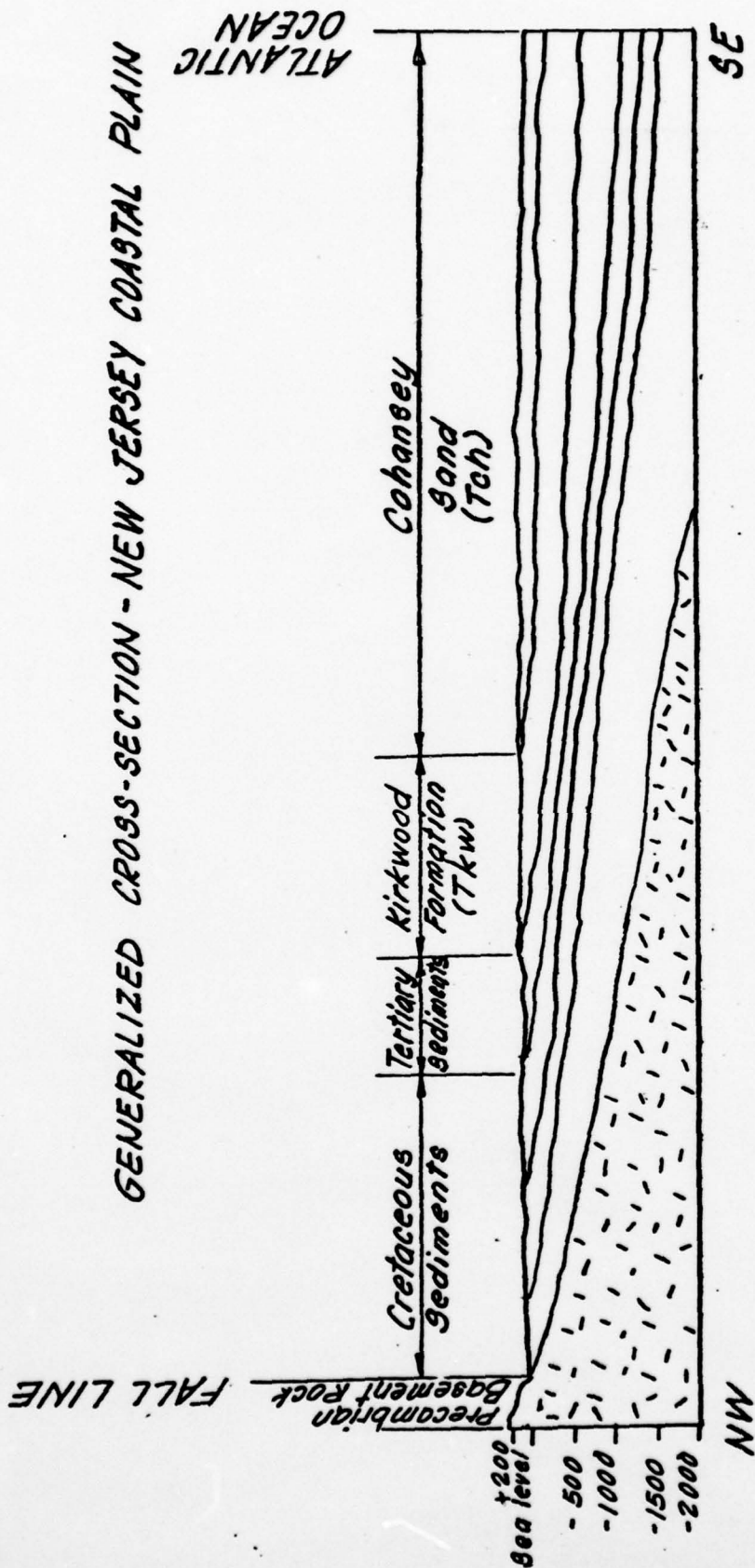
SCALE: AS SHOWN

JOB NO: J-783

CK'D. BY: D.J.L.

DATE: 6 JULY 1978

FIG. NO: 2



(After Lucey, 1977)

No Scale.

REGIONAL GEOLOGIC FEATURES Fig 3

APPENDIX 1

CHECK LIST

VISUAL INSPECTION

HANOVER LAKE DAM

Check List
Visual Inspection
Phase 1

Name Dam Hanover Lake Dam County Burlington State New Jersey Coordinators N.J.D.E.P.

Date(s) Inspection 6 and 14 July 1978 Weather Sunny Temperature 80-90° F

Pool Elevation at Time of Inspection 65.5 M.S.L. Tailwater at Time of Inspection 63.0 M.S.L.

Inspection Personnel:

A. Puyo _____
D. Leary _____
D. Lachel _____
J. Chaikin _____

D. Leary Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	Right embankment heavy vegetal cover and trees on both slopes.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosions occurring at both upstream and downstream embankment at wooden spillway abutments.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good	
RIPRAP FAILURES	No rip-rap.	

EMBANKMENT

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

JUNCTION OF EMBANKMENT
AND ABUTMENT, SPILLWAY
AND DAM

Erosion at spillway-embankment
abutments.

ANY NOTICEABLE SEEPAGE

No seepage but there is a marsh
area downstream of right embankment
that may be backwater.

STAFF GAGE AND RECORDER

Yes, in poor condition and numerals
undiscernable.

DRAINS

None observed

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	33 ft long crest. Tailwater (6.8-4.3) = 2.5 ft below upstream lake level. Upstream 0.5 ft higher than downstream edge of weir.	
APPROACH CHANNEL	None observed	
DISCHARGE CHANNEL	Stream	
BRIDGE AND PIERS	Aluminum bridge with wood decking. Cable suspended bridge over spillway. Pile supported concrete bridge about 400 ft downstream of spillway embankment.	

RESERVOIR

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SLOPES

About 20 horizontal to 1 vertical

SEDIMENTATION

Unknown

DOWNSTREAM CHANNEL

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

Bridge piling downstream of dam
could cause obstruction.

CONDITION
(OBSTRUCTIONS,
DEBRIS, ETC.)

Channel side slopes are about
4 horizontal to 1 vertical.

SLOPES

Downstream population reported to
be 7,144.

APPROXIMATE NO.
OF HOMES AND
POPULATION

APPENDIX 2

PHOTOGRAPHS

HANOVER LAKE DAM



View of spillway looking
upstream.

6 July 1978



Debris in discharge channel.

6 July 1978

HANOVER LAKE DAM



Vegetal growth in right
spillway embankment abutment.

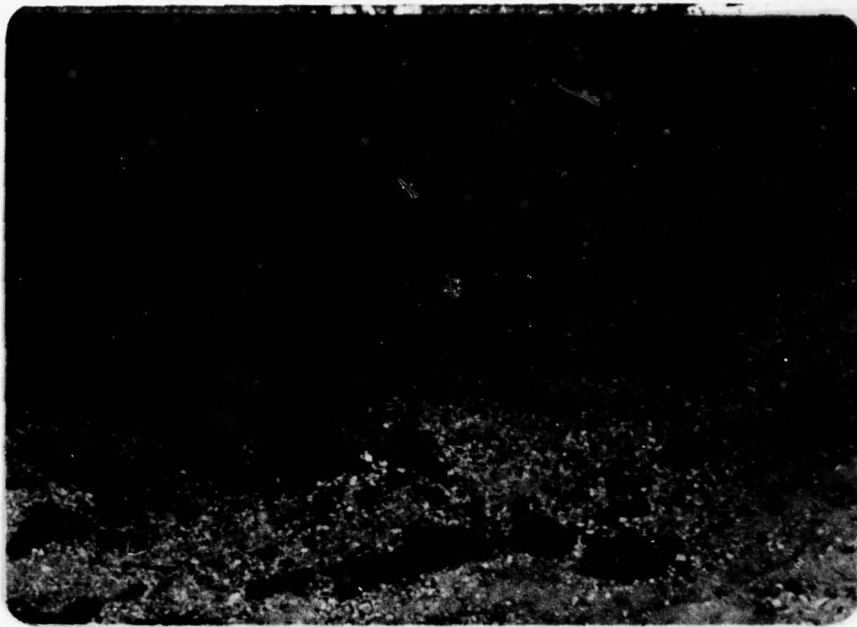
6 July 1978



Collapse of downstream
retaining wall at left
abutment.

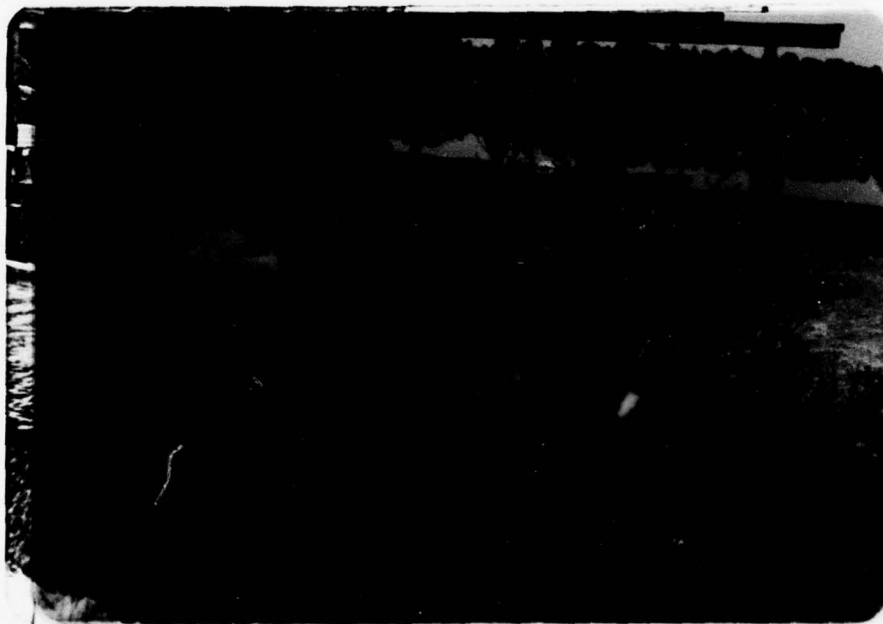
6 July 1978

HANOVER LAKE DAM



Asphalt in left embankment
and bridge support backfill.

6 July 1978



Erosion of downstream backfill
behind left bridge support.

6 July 1978

HANOVER LAKE DAM



Right sidewall of spillway. 6 July 1978
Note debris downstream of spillway.



Upstream view of wooden bridge pier abutments. 6 July 1978

HANOVER LAKE DAM



View of dam from left embankment. 6 July 1978
Note trees and vegetal growth
covering right embankment.



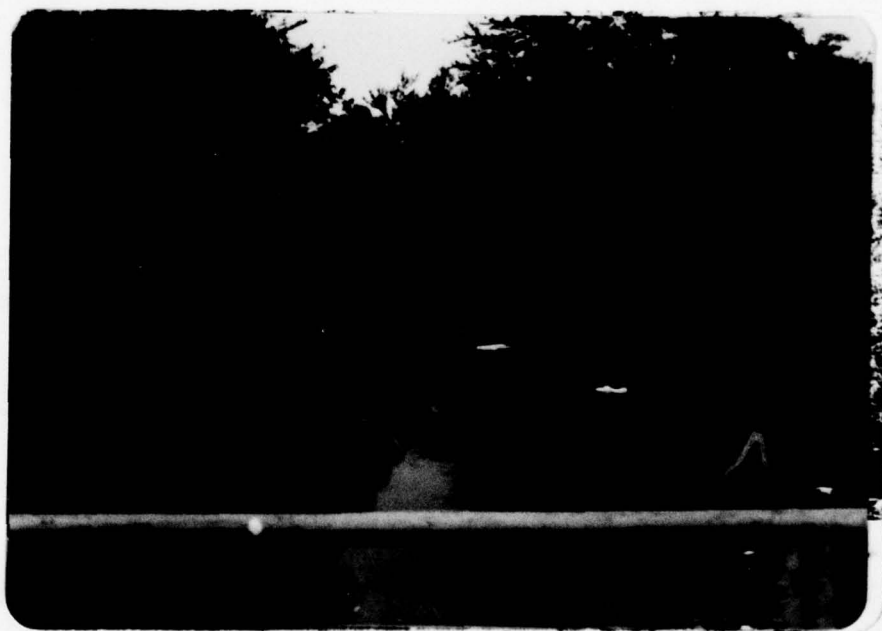
View of discharge channel 6 July 1978
from bridge looking downstream.

HANOVER LAKE DAM



Timber pile supporting concrete
highway bridge downstream of dam.

6 July 1978



Discharge channel looking
downstream from highway bridge.

6 July 1978

HANOVER LAKE DAM

APPENDIX 3

HYDROLOGIC COMPUTATIONS

HANOVER LAKE DAM

HYDROLOGIC CALCULATIONSHANOVER LAKE DAM

Location Burlington County, N.J. in the Delaware River Basin

Drainage Basin 19.77 sq mi

Area of Lake 90 acres

Classification Size - small < 1000 ac ft storage
Hazard - high

Spillway Design Flood $\frac{1}{2}$ PMF to PMF

Calculate $\frac{1}{2}$ PMF and PMF

1. Hanover Lake Dam located in Zone G

$$\text{PMP} = 24.0 \text{ inches (200 sq mi 24 hr)}$$

2. PMP adjustment factor

Duration (hr)	% of 24 hr	Reduction Factor *
0-6	106	0.8
0-12	116	
0-24	125	
0-48	137	

* p. 48 "Small Dams"

3. Methodology.

PMF to be calculated using HEC 1 and Clark Unit hydrograph coefficients. Clark coeff. determined from unpublished regression analysis determined by the Army Corp of Engineers (Phila)

BY _____ DATE 8/16 Hanover

JOB NO. J-783

CKD GED DATE 21 Aug

SHEET NO. 1 OF 10

Clark Unit Hydrograph Tc & R

CORPS of Engineer Eq's

$$\frac{R}{T_c + R} = 0.6$$

$$T_c + R = 21.0 \left(\frac{\text{Drainage Area (mi}^2\text{)}}{\text{Slope (}\frac{\text{ft}}{\text{mi}}\text{)}} \right)^{-2.2} (ST)^{.33} (K)^{-.28}$$

where

$$\text{Slope} = \frac{E_{85} - E_{10}}{L_{85} - L_{10}}$$

L_{85} = Length of 85% of The Main Channel
measured from the reservoir (mi)

L_{10} = length of 10% " (mi)

E_{85} = Elev at L_{85} (ft)

E_{10} = Elev at L_{10} (ft)

ST = % of lakes & swamps in
Storage area

$$K = 1.0 + (.3 \times i')$$

i' = % impervious surface
roads, bldg, etc.

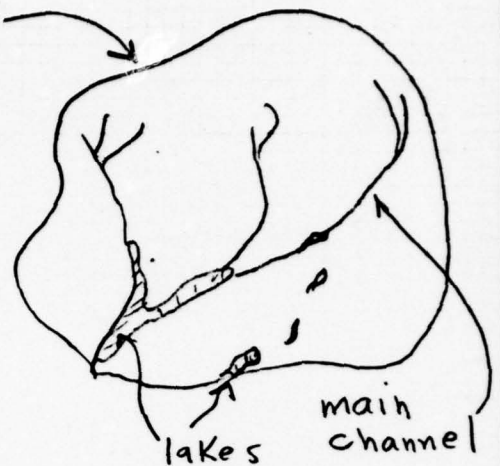
BY _____ DATE _____ Hanner

JOB NO. J-783

CKD GFD DATE 1 Sept

SHEET NO. 2 OF 10

Divide



Drainage area	19.77 mi ²
L ₁₀	0.45 mi
L ₀₅	3.86 mi
E ₁₀	90 ft
E ₀₅	120 ft
Slope	8.8 $\frac{ft}{mi}$
ST	17%
Z	1%
K	1.3

$$\therefore T_c + R = 21.0 \left(\frac{19.77}{8.8} \right)^{.22} (17)^{.33} (1.3)^{-.28}$$

1.19 2.55 .93

$$\therefore T_c + R = 59.2$$

$$\& \frac{R}{T_c + R} = 0.6$$

$$\therefore R = 35.5 \text{ HR.}$$

$$T_c = 23.7 \text{ HR.}$$

BY IC DATE 8/16 Harover

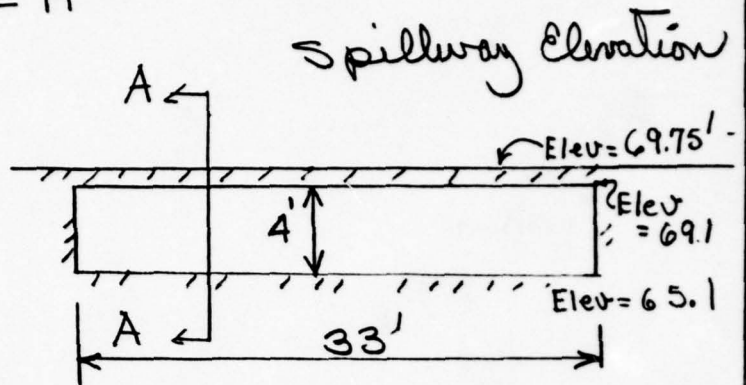
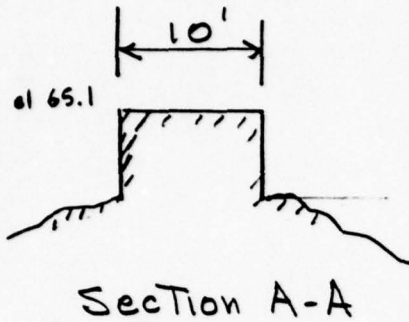
JOB NO. J-783

CKD GFD DATE 8/21
REV 9/1

SHEET NO. 3 OF 10

SPILLWAY CAPACITY

$$Q = CLH^{3/2}$$



King & Brater, pag 5-46 Table 5-3

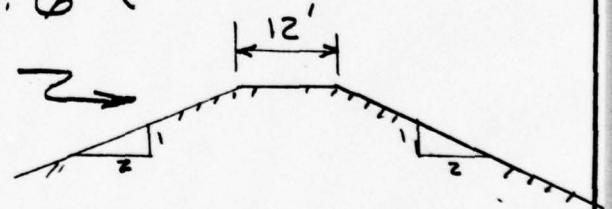
$$C = 2.64$$

$$L = 33 \text{ ft}$$

Reservoir:

Top at Elev 69.6 (Low Point)

Cross section



King & Brater

pag 5-49 Table 5-9

$$C = 2.98$$

BY JC DATE 8/12 Hanover

JOB NO. J-783

CKD GED DATE 8/21

SHEET NO. 4 OF 10

(ft) Elev	Spillway		Reservoir			Total
	(ft) H	(cfs) Q_{SPILL}	(ft) H	(ft) L	(cfs) Q_{RES}	(cfs) Q_{TOTAL}
65.1	0	0				0
65.3	0.2	8				8
65.1	1.0	87				87
67.1	2.0	246				246
68.1	3.0	453				453
69.1	4.0	697				697
69.6	4.5	832	0			832
70.6	5.5	1124	1	50	149	1273
71.6	6.5	1444	2	100	843	2287
72.6	7.5	1789	3	250	3872	5661
73.6	8.5	2159	4	300	7152	9311

Note: The effect of bridge on outlet capacity assumed to be small

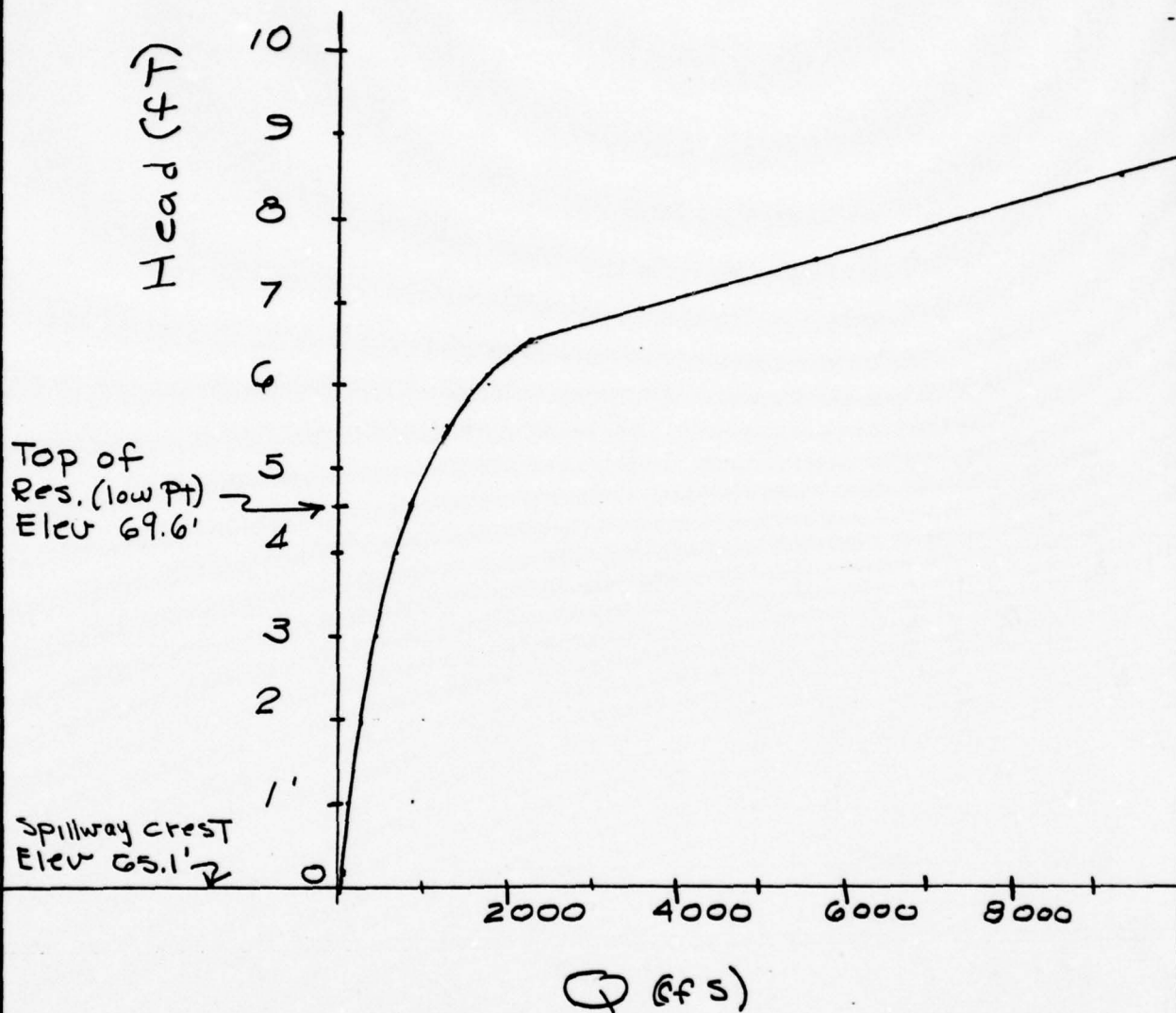
BY JC DATE 8/12 Hanover

JOB NO. J-783

CKD/KED DATE 8/21/91

SHEET NO. 5 OF 10

Spillway Capacity Curve



BY JC DATE 8/12 Hanover

JOB NO. J-783

CKD/TED DATE 8/21

SHEET NO. 6 OF 10

Reservoir Storage Capacity

Assume a linear distribution for the increase of the area with elevation.

Start at a zero storage at the crest of the spillway. Area of lake $\cong 90$ acres

From a site inspection the average slope of the land around the lake edge is 4 on 1
Lake perimeter = 24,000'

\therefore for a height of 1 foot above the crest the area of the lake has increased by

$$= \frac{4(24,000)}{43,560} = 2.2 \text{ acres}$$

Elev (ft)	H (ft)	increase in the lake Area (Acres)	Area of the lake (acres)	avg Area (acres)	Storage (acc-ft)
65.1	0	0	90	90.0	0
65.3	0.2	0.44	90.44	90.22	18.0
66.1	1.0	2.2	92.2	91.1	91.1
67.1	2.0	4.4	94.4	92.2	184.4
68.1	3.0	6.6	96.6	93.3	279.9
69.1	4.0	8.8	98.8	94.4	377.6
69.6	4.5	9.9	99.9	94.95	427.3
70.6	5.5	12.1	102.1	96.05	528.3
71.6	6.5	14.3	104.3	97.15	631.5
72.6	7.5	16.5	106.5	98.25	736.8
73.6	8.5	18.7	108.7	99.35	844.4

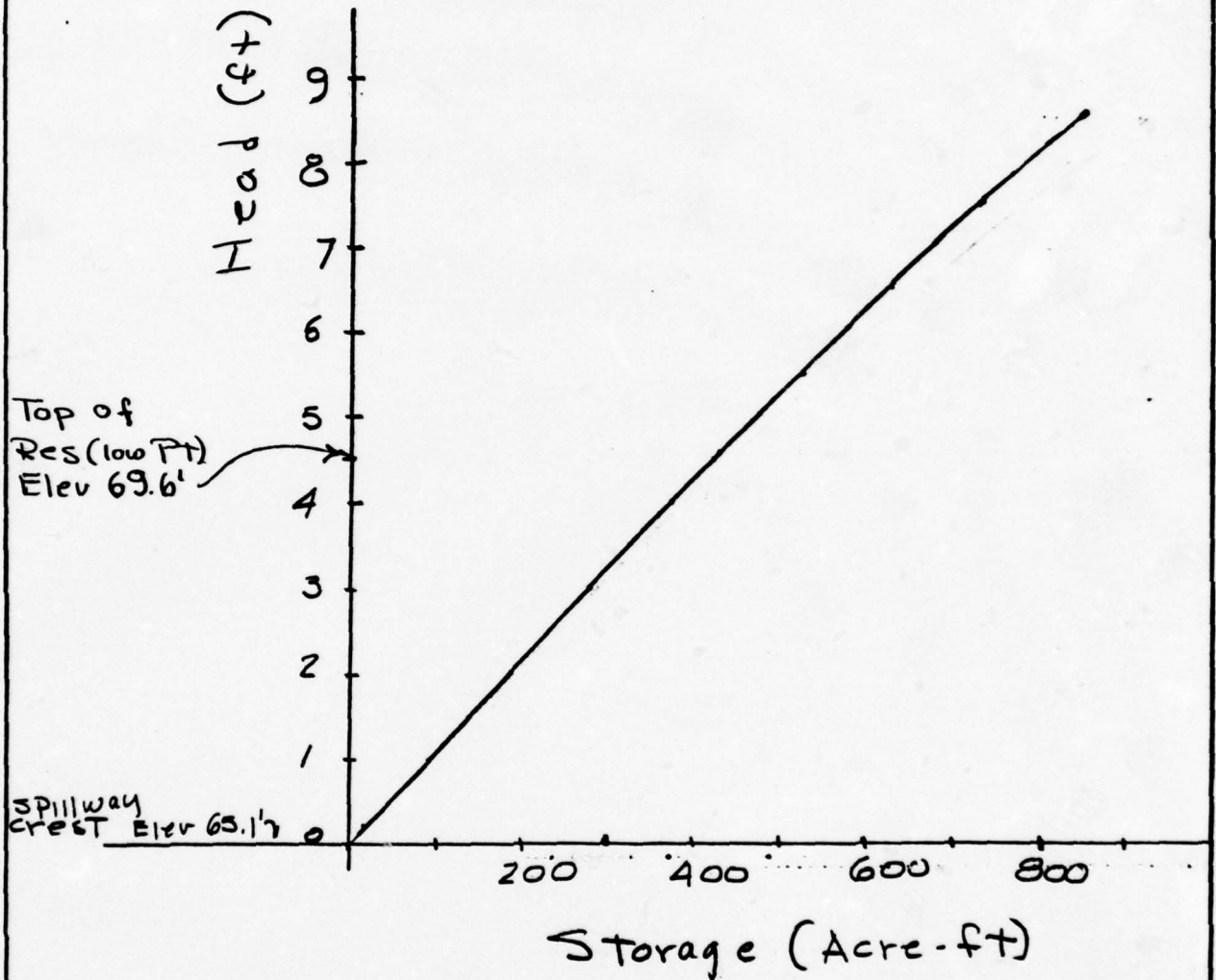
BY JC DATE 8/12 Hanover

JOB NO. J-783

CKD GED DATE 9/21

SHEET NO. 7 OF 10

Storage Capacity Curve



BY JC DATE 8/12 Hanover

JOB NO. J-783

CKD GED DATE 8/21

SHEET NO. 8 OF 10

Elev	H ft	Q cfs	Storage
65.1	0	0	0
65.3	0.2	8	18
66.1	1.0	87	91.1
67.1	2.0	246	184
68.1	3.0	453	280
69.1	4.0	697	378
69.6	4.5	832	427
70.6	5.5	1273	528
71.6	6.5	2287	631
72.6	7.5	5661	737
73.6	8.5	9311	844

← overtopping

HYDROGRAPH AND FLOOD ROUTING

1. Hydrograph and flood routing determined using HEC-1
2. PMF = 5224 cfs (routed to 5228 cfs)
 $\frac{1}{2}$ PMF = 2612 cfs (routed to 2616 cfs)
3. Routing indicates dam will overtop for both PMF and $\frac{1}{2}$ PMF by 2.8 ft and 2.1 ft respectively

BY _____ DATE 8/2/78 Hanover

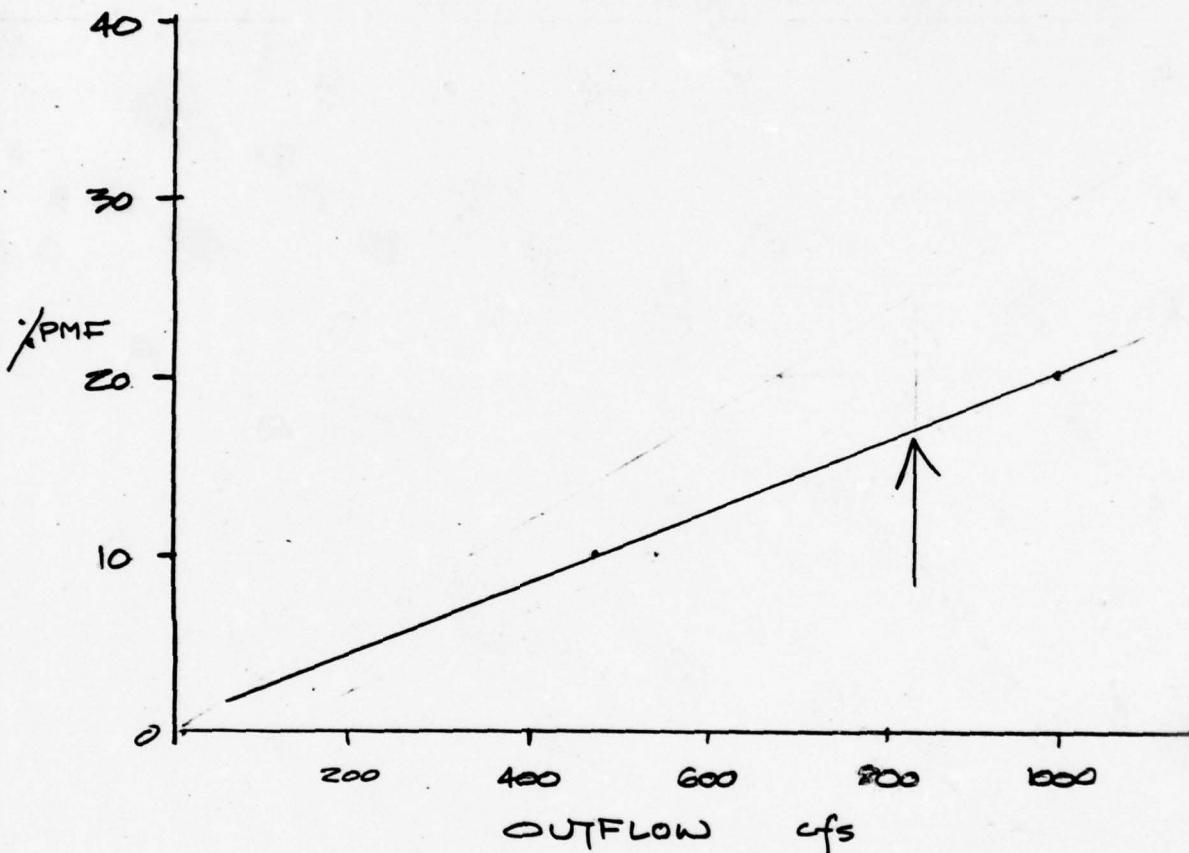
JOB NO. J-783

CKD *CFD* DATE 8.21.78
 9.1.78

SHEET NO. 9 OF 10

OVERTOPPING POTENTIAL

1. Various % PMF have been routed (HEC 1 attached)
2. Plot peak outflow vs % PMF



3. Overtopping occurs at a 69.6 ft \pm $Q \approx 830$ cfs
 \therefore dam can pass approximately 17% of PMF

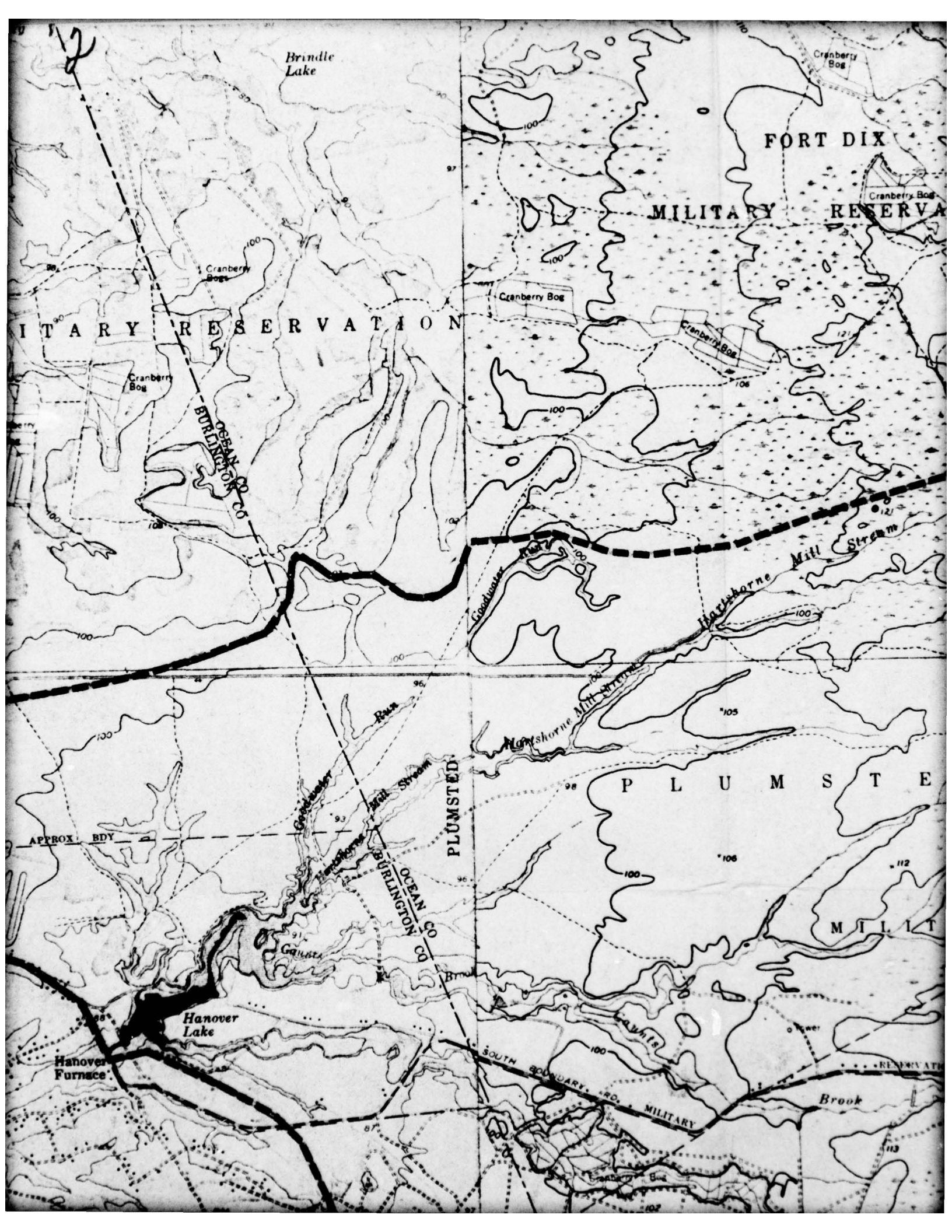
BY _____ DATE 8/12 Hanover

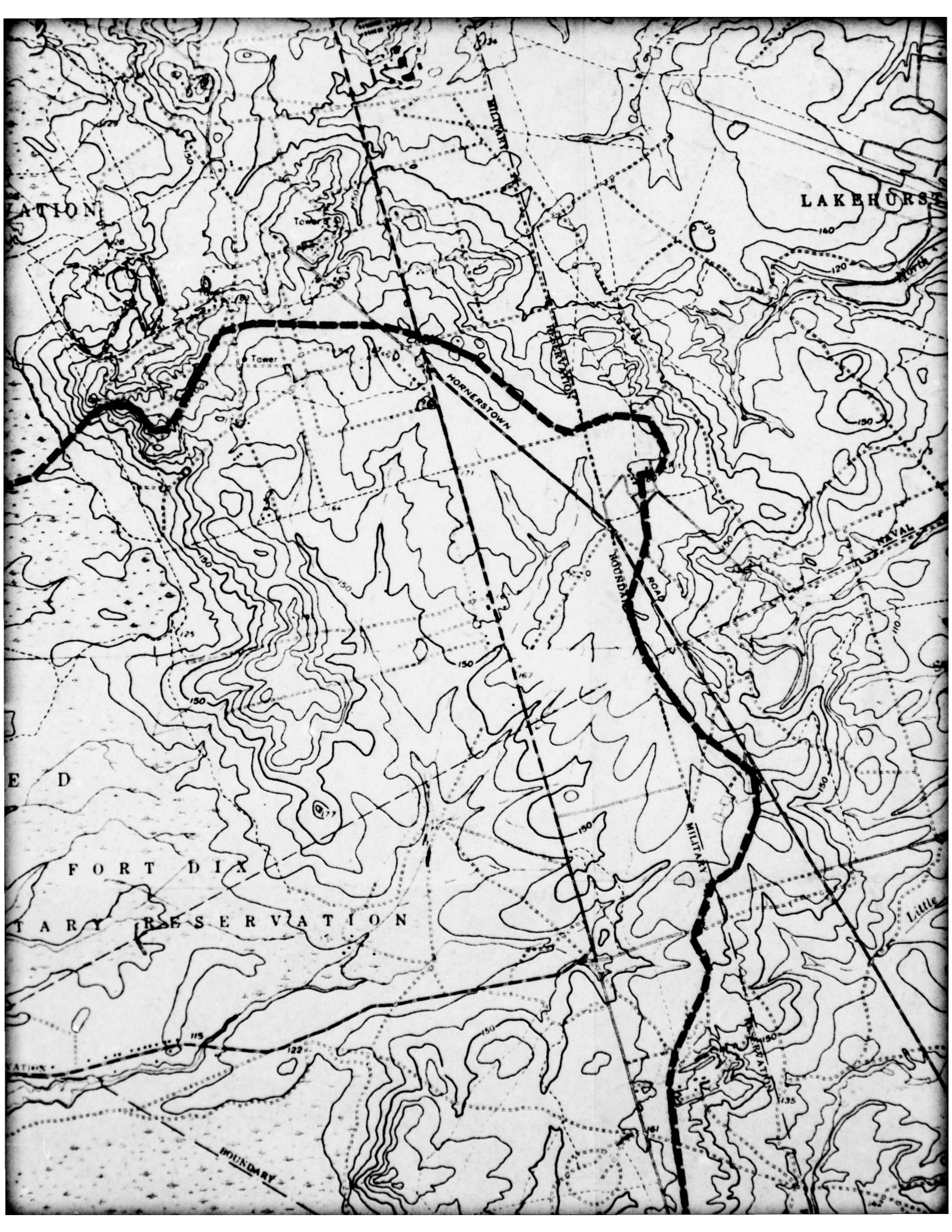
JOB NO. J-783

CKD GED DATE 8.21.78
9.1.78

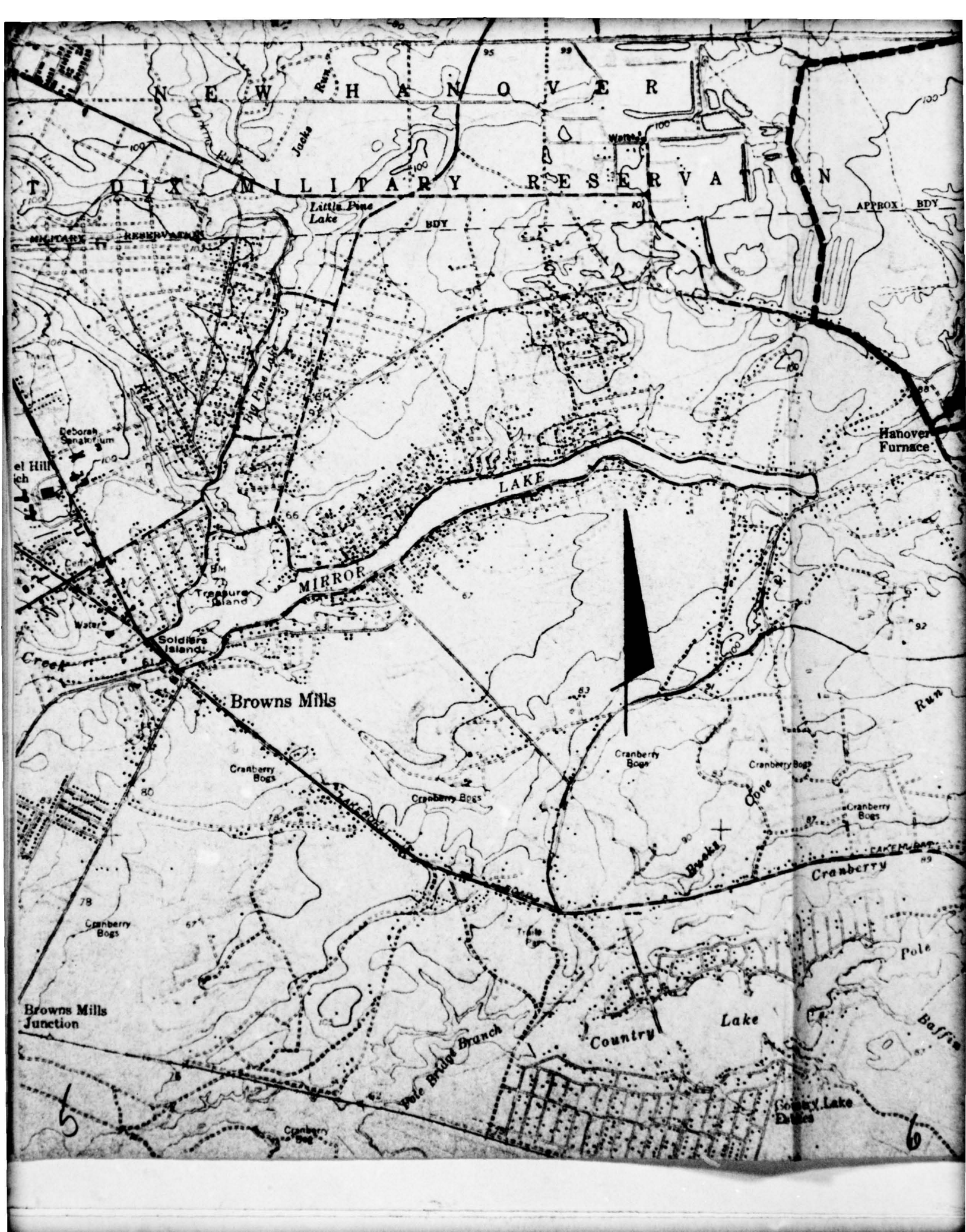
SHEET NO. 10 OF 10





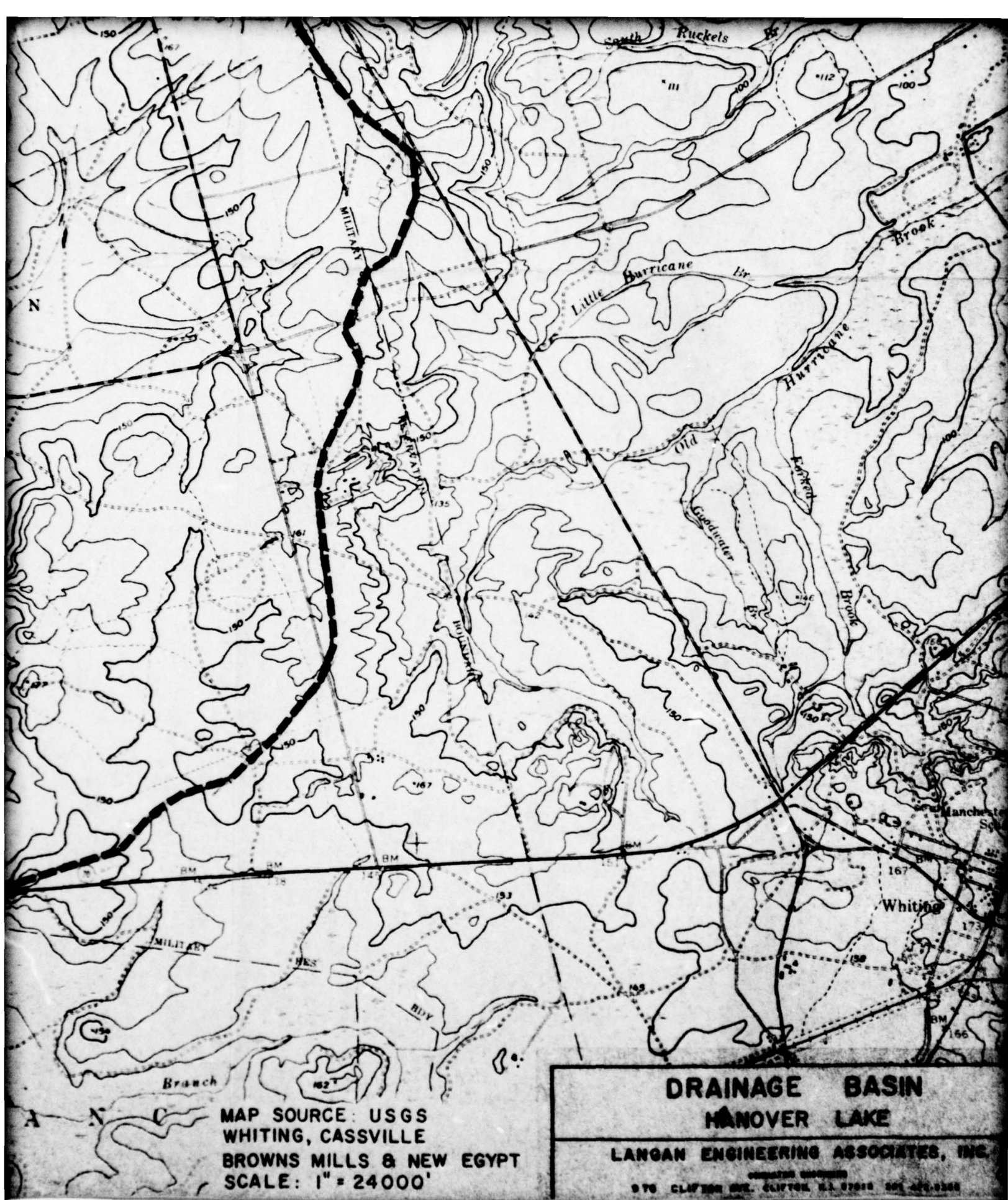












MAP SOURCE: USGS
WHITING, CASSVILLE
BROWNS MILLS & NEW EGYPT
SCALE: 1" = 24000'

DRAINAGE BASIN HANOVER LAKE
LANGAN ENGINEERING ASSOCIATES, INC. <small>CONSULTING ENGINEERS</small> 976 CLIFTON AVE. CLIFTON, N.J. 07011 TEL. 406-0368

HEC-1 OUTPUT

HANOVER LAKE DAM

listcf han6 'breakdown'-

HAN6 09:39 SEP 02,'78

ANDS09 JOB 0569 (LANG0242) IN BREAKDOWN
CDC1B LANG0242 0569

FT06F001

15.39.02 1 SEP 78

GED

GED

.....
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
.....

.....
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
.....

HANOVER LAKE DAM
DETERMINE INFLOW HYDROGRAPH FOR PMF AND ROUT
N.J. DAM INSPECTION

JOB SPECIFICATION
NO NHR NMIN IDAY IHR IMIN METRC IPLT IPRT NSTAN
150 2 0 0 0 0 0 0 0 0 0 0
JOPER 3 NHT 0

.....

SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH

INVDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	0	19.77	0.0	19.77	0.80	0.0	0	0	0
HYDROGRAPH DATA									
PRECIP DATA									
SPFE	PMS	R6	R12	R24	R48	R72	R96		
0.0	24.00	106.00	116.00	125.00	137.00	0.0	0.0		
LOSS DATA									
STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.20	0.0	0.0

UNIT HYDROGRAPH DATA
TC# 23.70 R# 35.50 NTA# 0

RECESSION DATA
STRTQ# -2.00 QMCSN# 0.0 RTIOR# 1.00

UNIT	HYDROGRAPH	100	END-OF-PERIOD	ORDINATES, LAG#	22.64	HOURS, CP#	0.45	VOL#	0.99
6.	23.	47.	76.	108.	142.	177.	207.	231.	249.
260.	261.	251.	238.	225.	212.	201.	190.	179.	169.
160.	151.	143.	135.	128.	121.	114.	108.	102.	96.
91.	86.	81.	77.	73.	69.	65.	61.	58.	55.
52.	49.	46.	44.	41.	39.	37.	35.	33.	31.
30.	28.	26.	25.	24.	22.	21.	20.	19.	18.
17.	16.	15.	14.	13.	13.	12.	11.	11.	10.
10.	9.	9.	8.	8.	7.	7.	6.	6.	6.
5.	5.	5.	5.	4.	4.	4.	4.	3.	3.
3.	3.	3.	3.	2.	2.	2.	2.	2.	2.

TIME	RAIN	EXCS	COMP	Q
1	0.02	0.00	40.	40.
2	0.02	0.00	40.	40.
3	0.02	0.00	40.	40.
4	0.06	0.00	40.	40.
5	0.06	0.00	40.	40.
6	0.06	0.00	40.	40.
7	0.51	0.00	40.	40.
8	1.04	0.49	42.	42.
9	0.41	0.01	51.	51.
10	0.03	0.00	63.	63.
11	0.03	0.00	77.	77.
12	0.03	0.00	93.	93.
13	0.23	0.00	110.	110.
14	0.23	0.00	127.	127.
15	0.23	0.00	142.	142.
16	0.64	0.24	156.	156.
17	0.64	0.24	170.	170.
18	0.64	0.24	187.	187.
19	5.29	4.89	234.	234.
20	10.79	10.39	395.	395.
21	4.27	3.87	727.	727.
22	0.35	0.00	1201.	1201.
23	0.35	0.00	1768.	1768.
24	0.35	0.00	2398.	2398.
25	0.0	0.0	3062.	3062.
26	0.0	0.0	3710.	3710.
27	0.0	0.0	4278.	4278.
28	0.0	0.0	4730.	4730.
29	0.0	0.0	5052.	5052.
30	0.0	0.0	5224.	5224.
31	0.0	0.0	5216.	5216.

32	3041.
33	4785.
34	4525.
35	4279.
36	4047.
37	3827.
38	3620.
39	3424.
40	3238.
41	3063.
42	2897.
43	2741.
44	2593.
45	2453.
46	2321.
47	2196.
48	2077.
49	1966.
50	1860.
51	1760.
52	1666.
53	1577.
54	1493.
55	1413.
56	1338.
57	1267.
58	1199.
59	1136.
60	1076.
61	1019.
62	965.
63	915.
64	867.
65	821.
66	779.
67	738.
68	700.
69	664.
70	629.
71	597.
72	567.
73	538.
74	510.
75	485.
76	460.
77	437.
78	415.
79	395.
80	375.
81	357.
82	340.

33	0.0
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35	0.0
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37	0.0
38	0.0
39	0.0
40	0.0
41	0.0
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72	0.0
73	0.0
74	0.0
75	0.0
76	0.0
77	0.0
78	0.0
79	0.0
80	0.0
81	0.0
82	0.0

33	0.0
34	0.0
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36	0.0
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70	0.0
71	0.0
72	0.0
73	0.0
74	0.0
75	0.0
76	0.0
77	0.0
78	0.0
79	0.0
80	0.0
81	0.0
82	0.0

Year	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050																																																																																																																																																																																																																																																																																																																							
1984	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461</

135	0.0	0.0	0.0	40.
136	0.0	0.0	0.0	40.
137	0.0	0.0	0.0	40.
138	0.0	0.0	0.0	40.
139	0.0	0.0	0.0	40.
140	0.0	0.0	0.0	40.
141	0.0	0.0	0.0	40.
142	0.0	0.0	0.0	40.
143	0.0	0.0	0.0	40.
144	0.0	0.0	0.0	40.
145	0.0	0.0	0.0	40.
146	0.0	0.0	0.0	40.
147	0.0	0.0	0.0	40.
148	0.0	0.0	0.0	40.
149	0.0	0.0	0.0	40.
150	0.0	0.0	0.0	40.
SUM	26.30	20.37	135165.	

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
5224.	5164.	4560.	3003.	135144.
CFS	2.43	8.58	16.96	21.20
INCHES	2562.	9048.	17878.	22349.
AC-FT				

HYDROGRAPH ROUTING

ROUTING COMPUTATIONS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	1	0	0	0	0	1
QLOSS	CLOSS	ROUTING DATA	AVG	IRIS	ISAME	
0.0	0.0	0.0	0.0	1	0	
NSTPS	NSTDLL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	0.

STORAGE#	0.	91.	184.	280.	378.	427.	528.	631.	737.	844.
OUTFLOW#	0.	87.	246.	453.	697.	832.	1273.	2287.	5661.	9311.

TIME	EOP	STOR	AVG	IN	EOP	OUT
1	1	6.	40.	40.	6.	
2	2	11.	40.	40.	11.	
3	3	16.	40.	40.	15.	
4	4	19.	40.	40.	19.	
5	5	23.	40.	40.	22.	
6	6	25.	40.	40.	24.	

29. 41. 30. 40.
 31. 47. 33. 33.
 35. 57. 37. 37.
 40. 70. 42. 42.
 47. 85. 49. 49.
 55. 101. 57. 57.
 64. 119. 67. 67.
 74. 135. 78. 78.
 85. 149. 89. 89.
 103. 163. 101. 101.
 122. 179. 112. 112.
 144. 211. 124. 124.
 166. 314. 149. 149.
 286. 561. 203. 203.
 496. 964. 297. 297.
 851. 1485. 431. 431.
 1665. 2083. 568. 568.
 2826. 2730. 648. 648.
 3638. 3386. 673. 673.
 4154. 3994. 690. 690.
 4661. 4504. 706. 706.
 4994. 4891. 716. 716.
 5203. 5138. 723. 723.
 5228. 5220. 723. 723.
 5084. 5128. 719. 719.
 4836. 4913. 711. 711.
 4574. 4655. 703. 703.
 4325. 4402. 695. 695.
 4090. 4163. 688. 688.
 3868. 3937. 681. 681.
 3659. 3724. 674. 674.
 3460. 3522. 668. 668.
 3273. 3331. 662. 662.
 3096. 3151. 656. 656.
 2928. 2980. 651. 651.
 2770. 2819. 646. 646.
 2620. 2667. 641. 641.
 2479. 2523. 637. 637.
 2345. 2387. 633. 633.
 2245. 2258. 627. 627.
 2148. 2136. 617. 617.
 2035. 2022. 605. 605.
 1925. 1913. 594. 594.
 1822. 1810. 584. 584.
 1724. 1713. 574. 574.
 1632. 1622. 564. 564.
 1545. 1535. 556. 556.
 1462. 1453. 547. 547.
 1384. 1376. 539. 539.
 1311. 1302. 532. 532.

59	4477	1168.	4477	1208.
60	513.	1106.	4477	1154.
61	501.	1047.	4477	1098.
62	488.	992.	4477	1042.
63	475.	940.	4477	988.
64	463.	891.	4477	936.
65	451.	844.	4477	887.
66	440.	800.	4477	841.
67	429.	758.	4477	808.
68	418.	719.	4477	775.
69	406.	682.	4477	740.
70	394.	647.	4477	705.
71	381.	613.	4477	673.
72	368.	582.	4477	642.
73	356.	552.	4477	611.
74	344.	524.	4477	582.
75	332.	497.	4477	553.
76	320.	472.	4477	525.
77	309.	449.	4477	499.
78	299.	426.	4477	474.
79	289.	405.	4477	451.
80	279.	385.	4477	431.
81	270.	366.	4477	411.
82	261.	348.	4477	392.
83	252.	331.	4477	374.
84	243.	315.	4477	356.
85	235.	300.	4477	339.
86	227.	286.	4477	323.
87	220.	272.	4477	308.
88	213.	260.	4477	293.
89	206.	248.	4477	279.
90	199.	236.	4477	266.
91	193.	225.	4477	254.
92	188.	215.	4477	243.
93	182.	206.	4477	234.
94	177.	197.	4477	224.
95	171.	188.	4477	215.
96	166.	180.	4477	207.
97	161.	172.	4477	198.
98	156.	165.	4477	190.
99	151.	158.	4477	182.
100	147.	151.	4477	174.
101	142.	145.	4477	167.
102	138.	140.	4477	160.
103	134.	134.	4477	154.
104	130.	129.	4477	148.
105	126.	124.	4477	142.
106	123.	119.	4477	136.
107	120.	115.	4477	131.
108	117.	114.	4477	126.
109	114.	111.	4477	121.
110	111.	108.	4477	116.
111	108.	105.	4477	111.
112	105.	102.	4477	106.
113	102.	99.	4477	101.
114	99.	96.	4477	96.
115	96.	93.	4477	93.
116	93.	90.	4477	90.
117	90.	87.	4477	87.
118	87.	84.	4477	84.
119	84.	81.	4477	81.
120	81.	78.	4477	78.
121	78.	75.	4477	75.
122	75.	72.	4477	72.
123	72.	69.	4477	69.
124	69.	66.	4477	66.
125	66.	63.	4477	63.
126	63.	60.	4477	60.
127	60.	57.	4477	57.
128	57.	54.	4477	54.
129	54.	51.	4477	51.
130	51.	48.	4477	48.
131	48.	45.	4477	45.
132	45.	42.	4477	42.
133	42.	39.	4477	39.
134	39.	36.	4477	36.
135	36.	33.	4477	33.
136	33.	30.	4477	30.
137	30.	27.	4477	27.
138	27.	24.	4477	24.
139	24.	21.	4477	21.
140	21.	18.	4477	18.
141	18.	15.	4477	15.
142	15.	12.	4477	12.
143	12.	9.	4477	9.
144	9.	6.	4477	6.
145	6.	3.	4477	3.
146	3.	0.	4477	0.

RUNOFF SUMMARY, AVERAGE FLOW

HYDROGRAPH AT	PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
ROUTED TO	1	5224.	5164.	3003.	19.77
	1	5228.	5171.	2985.	19.77

.....
 * MCDONNELL DOUGLAS AUTOMATION COMPANY ---ST. LOUIS MESSAGE OF THE DAY
 *
 *
 *
 * LABOR HOLIDAY SCHEDULE
 *
 *
 * THE ST. LOUIS ASP/JES SYSTEMS WILL DISCONTINUE OPERATIONS AT
 * 0830, SUNDAY, 3 SEPTEMBER. NORMAL OPERATIONS WILL RESUME AT
 * 0130, TUESDAY, 5 SEPTEMBER.
 *
 *
 * HAVE A HAPPY HOLIDAY.
 *
 *

MC DONNELL DOUGLAS AUTOMATION COMPANY -- ST. LOUIS
OS/MVT RELEASE 21.7 COMPUTER SYSTEM SY0

ASP JOB NO. = 0569 JOBNAME = LANG0242 START TIME = 15.38.45 START DATE = 09/01/78

STEP RESOURCES

STEPNAME	COND	COMP	CORE	REGION	DASD	DISK	TAPE	DASD	I/O	CPU	STEP	TIME	STEP
	CODE	CODE	USED	REQUEST	TRKS	UNITS	UNITS	(MIN)	(MIN)	(MIN)	MRU	(MIN)	MRU
GO	0000		194 K	194 K	100	1	0	.104	.000	.005		.057	.24
* TOTAL JOB USAGE *													
CPU (MIN)	I/O (MIN)			CPU USAGE	MAIN RESOURCE UNIT SUMMARY								
					--	--	--	RESOURCE OCCUPANCY (MRU)	--	--	INIT/TERM		
				(MRU)	CORE	DASD	TRKS	DISK	UNITS	TAPE	UNITS	(MRU)	JOB TOTAL (MRU)
.005	.104		.05		.12	.00	.02	.00	.00	.05		.24	

```

*** RUN LIMITS ***
CLIENT CHARGE NO.      1560972
CLIENT DEFINED SUB-ACC'TING
CLIENT DESCRIPTION     I/O (MIN)      3.00 DEFAULT
                                CPU (MIN)      .50 DEFAULT
                                PROGRAMMER NAME FIELD
                                CEO
                                JOB ENTERED SYSTEM
                                15.14.10    09/01/78

```

listcf han8 'breakdown'-

HAN8 10:00 SEP 02,'78

AMDS09 JOB 1511 (LANG0362) IN BREAKDOWN
COC1B LANG0362 1511

GED

GED

18.27.38 1 SEP 78

FT06P001

.....
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
.....

.....
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
.....

HANOVER LAKE DAM
6PMF
N.J. DAM INSPECTION

JOB SPECIFICATION
NQ NHR NMIN IDAY IHR IMIN METRC IPLT IPRT NSTAN
150 2 0 0 0 0 0 0 0 4 0
JOPER 5 NMT 0
5 0

MULTI-PLAN ANALYSES TO BE PERFORMED

RTIOS# 1.00 0.50 0.40 0.30 0.20 0.10
NPLAN# 1 NRTIO# 6 LRTIO# 1

SUB-AREA RUNOFF COMPUTATION

COMPUTE HYDROGRAPH

INHYD	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATC	(SNOW	ISAME	LOCAL
1	0	19.77	2.0	19.77	0.80	0.0	0	0	0
PRECIP DATA									
SPPE	PMS	R6	R12	R24	R48	R72	R96		
0.0	24.00	106.00	116.00	125.00	137.00	0.0	0.0		

LOSS DATA
STRK 0.0 DLTR 0.0 RTOL 1.00 ERAN 0.0 STRKS 0.0 RTOK 1.00 STRTL 1.00 CNSTL 0.20 ALSMX 0.0 RTIMP 0.0
UNIT HYDROGRAPH DATA
TC 23.70 R 35.50 NTA 0
RECESSION DATA
STRTO -2.00 QRCNS 0.0 RTIOR 1.00
END-OF-PERIOD FLOW
TIME RAIN EXCS COMP Q
SUM 26.30 20.37 135165.

HYDROGRAPH ROUTING

ROUTING COMPUTATIONS

ISTAQ 1 ICOMP 1 IECON 0 ITAPE 0 JFLT 0 JPRT 0 INAME 1
QLOSS 0.0 CLOSS 0.0 AVG 0.0 IRES 1 ISAME 0
NSTPS 1 NSTOL 0 LAG 0 AMSK 0 X TSK STORA 0
STORAGE 0. 91. 184. 280. 378. 427. 528. 631. 737. 844.
OUTFLOW 0. 87. 246. 453. 697. 832. 1273. 2287. 5661. 9311.

PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	1.00	0.50	0.40	0.30	0.20	0.10
HYDROGRAPH AT	1	1	5224.	2612.	2090.	1567.	1045.	522.
	2	2	0.	0.	0.	0.	0.	0.
WHIPPEN RD	1	1	5224.	2612.	2090.	1567.	1045.	522.

APPENDIX 4

REFERENCES

HANOVER LAKE DAM

APPENDIX 4

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